LIVE ARTICLES

ON

SPECIAL HAZARDS

No. 9

Weekly
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No. 9

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FOREWORD

In this the ninth volume of the series on Special Hazards which has been published in THE WEEKLY UNDERWRITER during the past nine years we are including a valuable article on marine insurance by Sir Douglas Owen—a synopsis of a recent address before the British Insurance Institute. This subject has grown in importance within the past two or three years beyond the wildest expectations of the marine underwriters themselves. The demand for information pertaining to this class of insurance has been so small that we feel sure that our readers will appreciate the inclusion of this article in this series, even though it does not pertain specifically to the business of fire insurance and does not represent a fire "hazard."

To those whose contributions have made the publication of this book possible, the publishers extend their hearty thanks and appreciation. We bespeak for this volume the same hearty welcome which has been accorded to its predecessors, many of which are now either in their second editions or out of print.

An index of the preceding volumes will be found at the end of this book. Fire underwriters and inspectors who are interested in accident prevention are respectfully referred to "Live Articles on Accident Prevention"—a twin series to "Special Hazards," but devoted to liability insurance. Agents who control surety lines should read "Live Articles on Suretyship."

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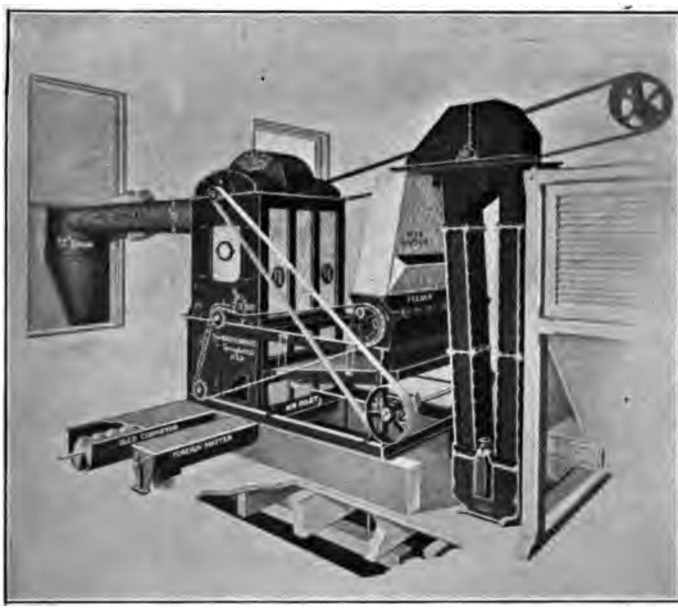
COTTON SEED OIL MILLS.

Remarkable Development of Processes Concerning Cotton Oil Products—Utilization Capable of Much Further Progress.

By Oscar A. Smith, Memphis, Tenn.

In these latter days of economy and utilization of what were formerly waste products there is no one substance which has



PNEUMATIC CLEANER.

shown such a remarkable development as has that of cotton seed—and there are those who are dreamers enough to say that we are only part of the way toward the complete development of the use of the cotton seed.

The culture of cotton has been practised in America since Jamestown was founded in 1620, but the utilization of cotton seed in the manufacture of oil and other economic products did not develop so early. The history of the development of the industry is replete with disappointing and costly experiments and experiences. So it may safely be said that the manufacture of cotton seed oil began about the year of 1870, but it has remained for the strenuous years of 1914, 1915 and 1916 to realize the fullest development of the utilization of all the products of cotton seed.

GOOD HOUSEKEEPING ESSENTIAL.

In no branch of the cotton industry does the matter of housekeeping play such a large part as in the manufacture of cotton seed oil. It is a matter which will largely determine the lines which the underwriter is willing to accept.

The material coming to the mill is dusty and dirty; contains bolls, sand, rocks and sometimes bits of iron. The processes carried on have a tendency to produce flying dust and lint and the meal and oil also have a tendency to get scattered. So the efficient oil mill superintendent sees to it that two or three men around the plant do nothing but clean up.

The operations in the modern oil mill are almost entirely automatic; the seed starting in at the sand and boll reel or cleaning machinery, passes by means of elevators and conveyors to the various other machines in their turn, so that there is no manual handling until the presses are reached.

The mills vary in size from a two-press or 40-ton mill, or a three-press or 60-ton mill, up to several hundred ton mill. This means that every twenty-four hours forty, sixty or more tons of seed pass through the milling processes. A two-press mill employs at least twenty men working in twelve-hour shifts, and this proportion holds good on through the larger mills. The majority of the labor employed is negro help.

COTTON SEED LINTER.

SEPARATORS.

As stated before, when the seed comes to the mill it is associated more or less with foreign matter, which must be separated at the initial manufacturing process. This foreign matter may be motes, hulls, sand, dirt, sticks, stones, bones or even metal. Some cotton gins are so set as to dump all of the refuse

into the seed conveyor. The seed is then loaded into cars filled with trash. Hence the seed cannot be clean when it gets to the mill.

It is unloaded from the cars, carried by screw conveyors and elevators over a screen for sand and dirt to the seed storage house and automatically dumped. These seed houses usually have a tunnel or tunnels running lengthwise the building in which the seed starts to the first process by means of screw conveyors. Some of the later mills have installed belt systems for handling the seed, and the time may come when some

PNEUMATIC SYSTEM ATTACHED TO LINTER GIN.

sort of pneumatic system will be installed to handle it from the seed storage house to the cleaning division. It has worked in the cotton gins for handling the seed, so it is not an impossible process for oil mills. Such a process certainly would work a great improvement in delivering the seed in removing some of the great causes of oil mill fires, for it is in the present screen conveyor systems that so often a fire originates from hot bearings. Underwriters now require the seed tunnel sprinklered where possible.

CLEANING.

The conveyors carry the seed to the seed cleaning machinery.

which has caused underwriters so much worry and so many losses in cotton oil mills.

In all plants the seed cleaning machinery is the first process through which the seed passes. In some plants the first machine is the sand and boll screen. This has a revolving reel covered with perforated metal or wire cloth, the greater proportion of which has small perforations for sand, the balance of proper size through which the seed passes. The larger foreign matter, such as bolls, sticks and other foreign substances, pass off and come out at the end of the reel.

The seed enters a conveyor, which delivers it to the cleaning process, thence over a shaker, thence down before the blast of a fan and over a series of magnets. By this process particles of iron, glass, small stones and other substances which have heretofore escaped the machines are thoroughly eliminated, delivering the seed to the linters as perfectly as can be done. The reel effects a separation by size and the cleaner makes a final separation by weight.

HULLERS, CYLINDER AND DISC TYPE.

REFUSE MATERIAL.

In some of the later mills may be found a "scientific" steel frame pneumatic seed cleaner. In this case the seed is delivered from the sand, boll reels into the boot of an elevator and carried to a point four or more feet above the feeder of the seed cleaner. The intervening space is occupied by a seed hopper with attachments for regulating the flow of seed to the machine. This system contemplates a cyclone collector outside the building. This avoids the scattering of the dust and light trash broadcast over the buildings and grounds.

In the foreign matter taken from the seed is also to be found the cotton bolls in which the seed cotton grew, and, at times,

premature bolls and seed with an extra amount of cotton attached. This refuse material, called grabots, is carried to a machine for reginning, so that the cotton may be reclaimed. The machine used is called a grabot gin. The material is delivered against a vertical running endless belt in which are a large number of sharpened fingers, which pick up the cotton, leaving the heavy refuse to be carried out at the base of the machine.

Right at this point is an excellent place to install a pneumatic system for taking this refuse to a burner, where it is consumed and the ash saved for fertilizer, which at the present time has a high market value.

The fingers on the belt deliver the cotton and seed to a series of saws somewhat similar to those in the ordinary gin stand, where the lint is cut off and baled and the seed returned to the conveying system running from the cleaners to the linter division..

Digrssing a bit, we will return again to the cleaning machines. Where no cyclone is connected with the system the flying lint and dust from the cleaning machines are sent by the blast from the aspirator or blower to a room or building made of wood frame and one-inch wire mesh walls lined with cheese cloth. This separates the dust from the lint and the result is an increase in the product of lint by the plant.

VALUES DEVELOPED.

Prior to 1914 this process was not given so much attention as linters and cotton fibre were not so valuable, and the oil millers found it more easy to discharge the dust flue into the open air outside the seed house. This resulted in an unsightly and untidy premises, and to a large degree contributed to the things which brought this class into disrepute with conservative underwriters.

COMMON HAZARDS.

These processes and machines are more often located in the seed house, occasionally in separate buildings and rarely in the newer mills in the main mill building. As oil mill fires originate more often in the seed cleaning room, underwriters prefer to have them sprinklered. Strange as it may seem, these fires do not arise from so-called special hazards peculiar to the industry, but from the common hazard of hot bearings resulting from lack of attention to a certain degree. It is now proposed to use Nigrum or other oilless bearings in the machines of this division as well as in the conveyors and elevator heads. Ball or roller bearings with compression grease cups would also remove the heating tendency, but these may be found more expensive than the oilless bearings mentioned.

The first process met in the main mill is that of linting the

seed. In other words, it is a process of reginning the seed in order to remove as much of the remaining lint as is possible, as the cleaner the hull is of lint the better the grade of meal produced and the larger production of oil.

The seed is fed automatically to the gin saws over a magnetic field, which removes most of the metallic substances that might produce a chance spark, which would result in a flash fire. Too much care cannot be given to these magnets, for experience has shown that there are times when metal gets by them into the saws of the linter gins.

LINTERS.

The lint, called "linters," is cut from the seed by the rapidly revolving saws and conveyed by the draught produced by the brushes in the same manner in the cotton gin. These brushes revolve faster than the saws, but in the same direction to a slowly revolving wire gauze drum on which it is collected and is either wound on a roll to a convenient size or dropped on a belt, carrying it to an adjoining room, where it is baled. This room is preferably cut off from the mill by double automatic fire doors and the walls standard parapeted. This requirement has resulted from the experience of the underwriters.

In some of the newer mills the brush system of the linters is replaced by a pneumatic system made by the Shreveport Blow Pipe Works, Shreveport, La. This system takes the lint as it comes from the seed and carries it directly to the press room. Linter rooms, where equipped with this system, are free from the flying lint and dust so often seen in the older mills. There is no reason why this system should not be granted a preferential rate in insurance because it makes a wonderful transformation in the linter room. The pneumatic system has been successfully applied to the cotton gin—it will likewise prove successful in the linter room.

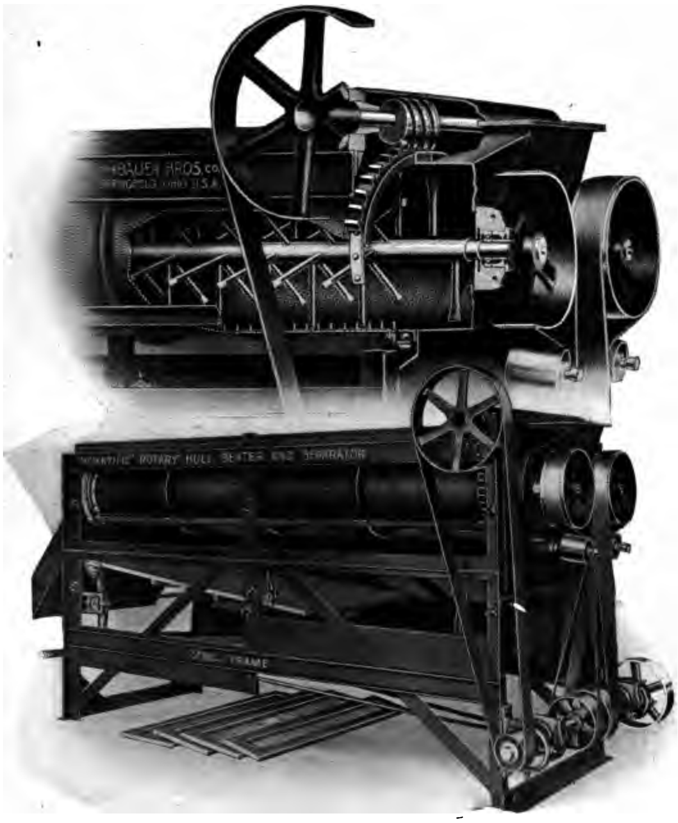
HULLERS.

The seed, now with only a slight covering of lint, drops down into a screw conveyor, where it is carried in some mills to another machine, which delints it so much as to leave only a small amount of fibre at the small, depressed end of the seed. In the ordinary mill the seed goes from the linters to the hullers, where the hard husk is cracked or broken, so that the kernel or meat of the seed may be separated for cooking.

The hullers consist of a cylindrical case containing horizontal knives fastened upon its inner periphery. The cylinders are perfectly balanced in order to secure the best working of the machine. These knives are made of the best steel and well tempered. Within this cylindrical case is a revolving shaft or drum, upon which is another set of knives. These knives are so set as to barely miss the knives on the inner side of the case. The seed falling into the machine from a feeder is cut to pieces

and the mixture is delivered to the separators, where the hulls are removed from the meats.

In the more modern mills a magnet is interposed in the conveyor system just before the seed enters the hullers. One asks, "Why put the magnet here?" In the most completely safeguarded mills magnets are interposed before each machine or process where there is a likelihood of any sparks from metallic



ROTARY HULL BEATER AND SEPARATOR.

substances coming in contact with the machines. All the metal may be taken from the seed before it enters the linters, and notwithstanding this, metal may be found in the seed when it gets to the huller magnets. This arises from loosened nuts or washers or broken parts dropping into the conveyors.

PRECAUTIONS.

The more careful mill superintendents require their help to brad or upset the bolts after the nuts have been screwed up. Some permit a lock washer to be used instead where two metallic substances are bolted together, but the majority now prefer to upset the bolts.

One now realizes why so much care is used in getting out all foreign residue. Think what a stone, a nut or bolt would do to a huller!

The separator machines are a series of shakers for removing the larger part of the meats, the residue passing over the final shaker, consisting principally of hulls and fibre and a small amount of meats in finer form. This goes then to the meat reel, which is a cylindrical sieve revolving slowly.

The final residue is called by trade name of "hulls," which is sold for cattle feed or for use in the fibre mills.

Some oil mills, since the European war began, have run the hulls through another series of gins, taking off another bit of lint or fibre. The final residue is little more than the bare hulls, which are sold to the dairymen for roughage for his cattle or to feed mills which make stock feed.

CRUSHING ROLLS.

MAXIMUM PRODUCTION.

In these days of close competition for business and the high price of seed the oil millers must produce the maximum products from every ton of seed worked. They must see to it that not more than one-half of one per cent. of oil can be found in the hulls after working and that the percentage of ammonia must be of a certain standard. Unless this is done a loss ensues, one that is avoidable. This has necessitated the installation of more scientific machinery than has been used in the past. The disc type of huller is illustrated in this article.

MEAL REEL.

In this machine the seed comes from the linters to the disc huller. From the huller the mixture falls upon the shakers, which separate a part of the meats (meal) and permits the hulls and uncut seed to go to the beater, where such meal as adheres to the hulls is taken out and the hulls and uncut seed sent to the next huller. The discharge from this huller goes upon a series of shakers, then to beaters as before, and the final residue sent to the hull house with not more than .05 per cent. of oil clinging to the hulls.

According to our idea, this machine should improve the desirability of the mill as a fire risk.

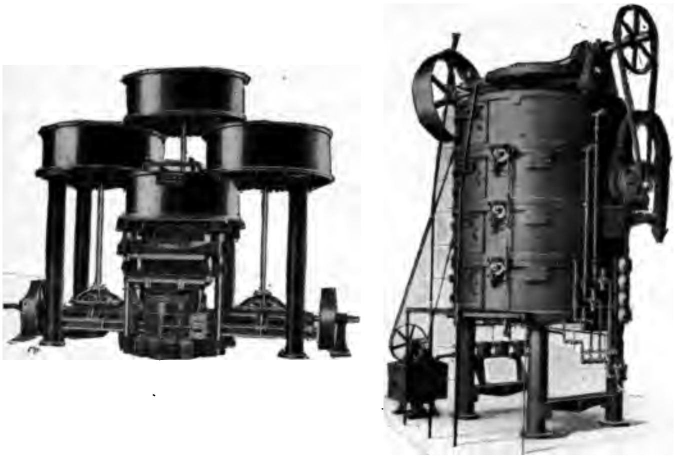
The meats coming from the separating machines are next delivered to the crushing rolls, where they emerge in a very thin, flaky fineness, so that a full yield of oil may be secured when the cooked meat is subjected to hydraulic pressure further on in the processes.

COOKING.

The next process is cooking, which brings the meats into such a condition that, on pressing, the oil is released. The meats come from the crushing rolls by means of conveyors and elevators to the heaters.

The old style cooker is made of cast iron and is steam jacketed on the sides and bottom. The sides are usually insulated against waste of steam. The heaters are set upon heavy iron frames. They are provided with agitators driven by gearing so as to bring

every bit of meat in contact with the heated portions of the cooker and thus evenly cook the mass. A charge of about 700 pounds of meats is put in the cooker at one time. If the meats appear too dry, moisture is admitted; if too soft, the steam is withheld. The period of cooking varies from 20 to 120 minutes, according to the dryness of the seed before crushing.



COOKERS—OLD AND NEW TYPES.

From the cooker the charge is passed to the sub-heater, which is also heated by steam jackets on the sides and bottom. This machine enables the operator to empty the entire charge of the cooker at one time, so that there will be no mixture of the raw with the cooked meats. The charge in the sub-heater is gradually worked out into the cake former, where the meats are prepared for the hydraulic press.

AUTOMATIC PROCESS.

In the newer mills automatic continuous cookers are installed. They give a much better and more economical result than the older types of cookers. They save a large amount of floor space, labor and power and also increase the quality and yield of oil due to uniform cooking. There is no possibility of making cake from uncooked meal as was the case in the old style machines.

These kettles vary in size and height. They are placed one above the other. Their bottoms have long narrow slots used

as gates for the discharge of the cooking mass to the next lower kettle. These slots are fitted with an adjustable automatic gate, which perfectly controls the level of the meats in each kettle, preserving about 6-inch air space above the meats. These gates have an automatic locking attachment, which keeps them closed until the kettle next below is emptied. As the lower kettle is emptied the gate in its bottom is closed and the gate next above is opened. These automatic attachments may be instantly adjusted to handle meal of any condition.

.Each kettle has its own separate steam pressure regulator, steam gauge and steam trap, which permits carrying different steam pressures on the side walls and bottom of kettles. These kettles have special type of stirrers so arranged as to make an even distribution of the meal while being cooked.

The top kettle is provided with a low meal alarm, which gives notice by the blowing of a whistle whenever the level of the meats drops below the center line.

Each set of cookers is equipped with a special exhaust fan connected to kettles 2 and 3 for removing excess moisture when required; a special steam and water spray valve to distribute moisture among the meats in the top kettle if too dry.

These machines may be started out on Monday morning and operated continuously for the remainder of the week, and this may be done without even the suspension of a meal cook.

SAVINGS.

To recapitulate, the manager of the newest oil mills may estimate his savings with an automatic continuous cooker as follows:

1. Cutting out meal cook on day and night watch.
2. Increased yield of oil, probably one gallon per ton and upward.
3. Reduction of press cloth expense.
4. Improved grade of bleachable oil with low refining loss.
5. Saving one-half the power to operate.
6. Saving of steam.
7. Saving of floor space and reducing temperature of press-room in hot weather.

CAKE FORMERS.

The cake former receives the meal and forms it into cakes of the proper size to be inserted into the boxes of the presses. On this machine is a meal box, which is filled by a sliding carriage. This is automatically thrust forward over the pan containing a press cloth of camel's hair about 6 inches long, the center of the cloth being in the center of the pan, and the ends hanging out. As the meal box returns for another charge an attendant rapidly folds the ends of the cloth upon the top

of the charge, picks it up on a paddle and shoves it into a section of the hydraulic press.

The oil press is a very important piece of apparatus to the oil miller, and the results obtained here show whether the previous operations have been efficiently done.

The press being filled with cake, hydraulic pressure is turned on so that finally a pressure of 2,000 to 4,000 pounds per square inch is exerted. This varies with the different ideas of the millers. After full pressure is exerted a small space of time is permitted for the cakes to drain. Then the pressure is released, the steaming cakes withdrawn and the press cloths pulled off to be used again.

The crude oil is pumped into a settling tank where the heavy residue collects as "foots" and the clear oil pumped to tank cars for delivery or to metal storage tanks for future delivery.

The cake is stored for drying. Some of it is sold as cake for foreign shipment. Such as not sold in this stage are then sent to a machine which revolves at a speed of 300 to 350 revolutions per minute. The cakes are fed into the machine as fast as it will receive them and broken into pieces about the size of a nut, so that they may be conveyed mechanically to the meal mill.

The grinding mills are in many instances burrstone mills, but more commonly and much better are attrition mills of a well-known type. The finely ground meal is sacked and sold for many purposes—fertilizer and feeds for live stock being principal uses.

Thus far we have only described the processes carried on. This has been done in a consecutive manner, so that one can form an idea as to the various operations.

STORAGE.

The storage of seed in large quantities has been thought dangerous by some underwriters, who feared spontaneous combustion from heating seed. It is doubtful that a fire has been caused by such. Green or damp seed will heat if bulked and permitted to stay unchanged. Oil millers keep close check on the seed to detect this tendency. Long iron rods sufficient to reach to the interior of the piles are thrust into the seed and permitted to remain. Any heating of the seed will show up on the rod in increased temperature. The miller or some of his sub-foremen go over the seed houses two or three times a day, taking hold of each rod with his bare hands to detect any change in temperature. If any heating is discovered the seed will be shoveled over and the pile opened up to cool off.

UNDERWRITING FEATURES.

Discriminating underwriters are paying a great deal o. attention now to the buildings. Some even refuse to write a sprin-

klered frame oil mill while others write the frames when sprinklered, but declining the unsprinklered frames. Unsprinklered frame seed houses are not objectionable if the seed cleaning machinery and the seed tunnel are sprinklered. Most seed houses are frame, a few are of steel frame iron clad construction, but none are brick. Some mills now are constructing cylindrical steel tanks for storage of seed, claiming that the seed will not heat and the fire insurance rates are not so high.

Some of the trust mills in casting about for improved methods of storing seed have hit upon hollow tile construction for the storage of cotton seed. These are considered by experts to be more economical, provide larger capacities and give more general satisfaction in handling of the seed.

TILE TANKS.

It has been found that specially constructed tile from shale and fire clay has proven amply strong enough to sustain any weight that might be put upon it. The first of these new tanks has now been completed nearly two years and as an evidence of the satisfaction and economy given the Buckeye Cotton Oil Company has ordered several large hollow tile tanks for their various plants. A number of other large oil producers have followed this plan also.

CAKE FORMER.

CAKE BREAKER.

The tile generally used is 8 x 12 x 12 inches, with six or more cells, and has a semi-circular three-inch hand-cut groove in the end of the outer cells. When a ring of tile is laid up this cut becomes a continuous groove, into which the steel and cement are placed. Reliance for resisting bursting pressure is mainly on the reinforced concrete. The roofs are of either steel or reinforced concrete, and the walls have been found to carry the latter with the usual factor of safety. The floors are of concrete resting upon a bed of dry cinders. The size that has been found most convenient for operation and economical in construction is 50 feet in diameter by 60 feet high, although

some of these tanks have been erected with a diameter of 75 feet.

These tanks are of low cost, have no expense in maintenance and effect a large saving in insurance rates. In some cases it has been estimated that ordinarily the insurance premiums on the present high price of seed will pay for the building of hollow tile tanks in from two to four years. This is where frame seed houses are compared with the hollow tile type.

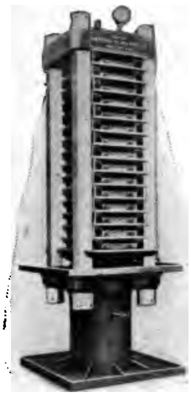
This change in the seed houses should go far toward the improvement of the class from an underwriting standpoint.

The mill building should be of brick, mill type and sprinklered. There should be at least three fire divisions here, viz.:

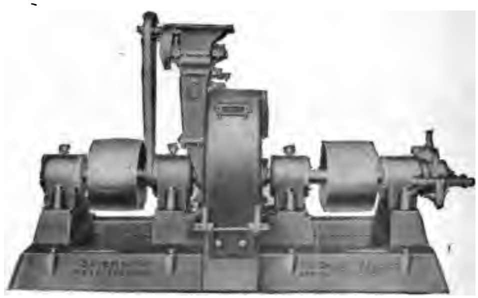
Linter room.

Linter pressroom.

Huller and cooking room.



COTTON SEED PRESS



ATTRITION MILL

This might be varied by putting the hullers and separators in the linter room. With this subdivision of the hazards the experience should be good.

The experience in a frame mill building has not been good where unsprinklered. There may be several reasons for this. Frame mills are usually of flimsy or light construction, the parts settle out of line, the vibration of the machinery weakens the building and it is not long before hot bearings show up and later a fire ensues. Again, frame buildings are not kept in as good condition as the brick and fireproof mills. It is a case of housekeeping and not special hazards which determine the profit

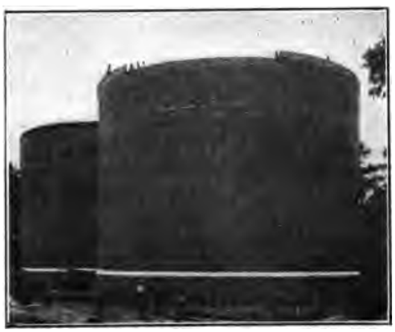
in such a mill. The common hazards largely determine the profit in frame mills.

It is needless to discuss the power plant buildings. They really should be in two divisions. The engine room and machine shop should be one of these and the boiler house should be cut off in standard manner.

Depreciation of an oil mill and its component parts on account of age and usefulness must be considered in underwriting. Repairs each year in the dull season do not bring the mill up to new conditions and value. From the time the mill is completed and set in operation it begins to depreciate. Agents and underwriters should consult with the oil mill owners and see that proper consideration be given this subject.

The mill building, if built of brick with standard fire walls and good foundations, will have a useful life of forty to fifty years. The seed house, on account of construction and the extremely hard use, will do well to last twenty-five years, and the repairs made each year will amount to a considerable percentage. The hull house has a yet shorter life. Seed house machinery usually lasts for fifteen or twenty years with about 5 per cent. repairs necessary per annum.

The linter room machinery usually is good for twenty-five or thirty years with about 3 to 4 per cent. repairs necessary, when considering the life of the linter belts five to six years. The separating equipment is usually counted in the linter room.



TANKS OF HOLLOW TILE

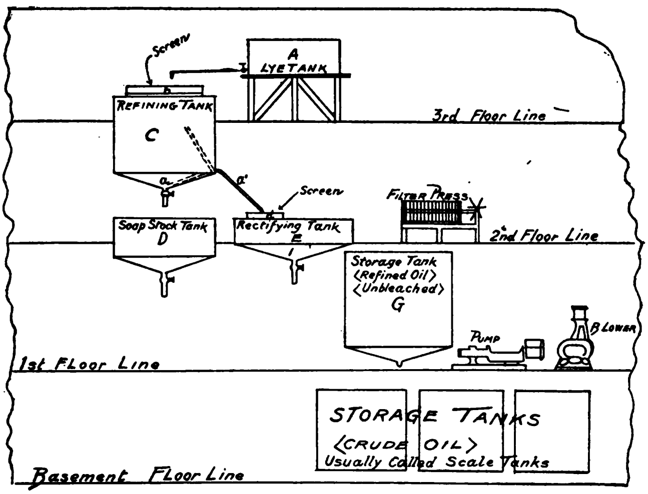
The pressroom equipment should have a life of from twenty-five to forty years with 1 to 2 per cent. per annum repairs. Roll belts do not last much over three years in the average mill. The meal room equipment lasts about twenty-five years with 4 to 5 per cent. for repairs. The power plant can usually be considered to have a life of twenty-five to thirty years. The boilers are first to give out, and the quality of feed water is such, in some localities, that their lives are shortened in ten years, and in some cases to six or seven years. Repairs will run about 3 per cent. annually, averaged over about five-year periods when the boilers are reset, which properly belongs to the repair account.

COTTON OIL REFINERIES.

Variation in Detail of Processes—General Principles Identical—Good Risks Generally.

By Oscar A. Smith, Memphis, Tenn.

Cottonseed oil belongs to the semi-drying or intermediate class of vegetable oils. Linseed oil readily absorbs oxygen and thus "drys" readily, while olive oil does not and is called "non-drying." Linseed oil, if permitted to take up oxygen while in a finely divided state, like a film on cotton or other fiber waste, is very



Section of Crude Oil Refinery
<Caustic Soda Process>
<No Lard Compounding.>

prone to ignite spontaneously. Cottonseed oil absorbs such a small amount of oxygen that even in most favorable circumstances rarely exhibits this tendency. It is for this reason that underwriters should not confuse the cotton oil refinery with the

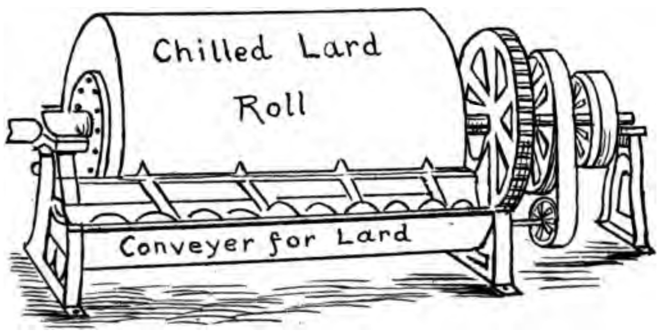
linseed oil refinery or with the so-called grease risks, which are so conducive to fires. Underwriters, except those who have come up from special and local agencies in the South, so often confuse one with the other, and if they approve any lines at all, do so sparingly and grudgingly. If they could get to see some of these refineries and get well acquainted with the hazards they would have a quite different attitude toward them.

ESSENTIALS SIMILAR.

The refining of crude cottonseed oils varies considerably in details, but the essentials are similar in that all are based upon the use of caustic alkali of some description, but principally caustic soda.

Crude oil, coming to the plant in tank cars, is pumped into storage tanks, usually situated outside of and away from the buildings. From these as needed the oil is pumped into the refining tank, which is circular in shape, of sheet iron, usually of 5,000 to 10,000 gallons capacity, being larger in diameter than in depth. In this tank the oil is agitated or stirred as the alkali water is mixed in.

At the bottom of the tank is a system of closed steam coils, 1½ inches in diameter; these usually extend up along the sides about one-third of the way. These furnish the heat which is



necessary for the proper refining of the oil. The oil is heated to about 80° F., then the alkali solution is let in and the mixture stirred slowly. The appearance of the oil changes shortly after the introduction of the alkali and in from fifteen to twenty minutes it will be noticed that the oil is now clear and intermixed with small blackish clots. The alkali is then shut off and the agitation slowed down to a slow rolling motion. Then the mass is heated to 100° to 120° F., when the heavy particles called soap stock rises to the top and the clear oil falls to the bottom. The

time required for the refining operation is usually thirty to forty-five minutes and the settling process four to five hours. In no case must the temperature exceed 130° F.

The clear oil is then drawn from the tank by a siphon into the finishing or rectifying tank, and the remaining mass, a brownish material consisting of soap, mucilaginous matter, coloring matter and other impurities mixed with more or less of the refined cottonseed oil. This goes by the name of "foots." This is withdrawn into a soap stock tank, where it is heated by a closed steam coil in the kettle and the remaining oil removed as far as practicable. The stock is then cooked and barreled in a fluid condition and sold to soap manufacturers.

REFINING PROCESS.

When refined for industrial purposes, before receiving the caustic soda solution, the cottonseed oils may be heated as high as 110° F. After the cold lye has been added and the proper breaking of the oil observed, the supply of caustic solution is shut off and the kettle heated, as before stated, to 130° F., the agitation being continued during the heating process. After this temperature has been reached the heat is shut off and the agitation stopped and the oil allowed to settle as usual. The oil is then drawn into the rectifying or refining tank, where it is heated to 250° to 285° F., in order to brighten it. This heating takes away the desirability of the oil as an edible substance.

Going back now to the processes connected with the manufacture of edible oils, we find the next tank is the bleaching tank, which is a cone-bottomed boiler, iron or steel tank, fitted with heating coils, a blower pipe and a siphon.

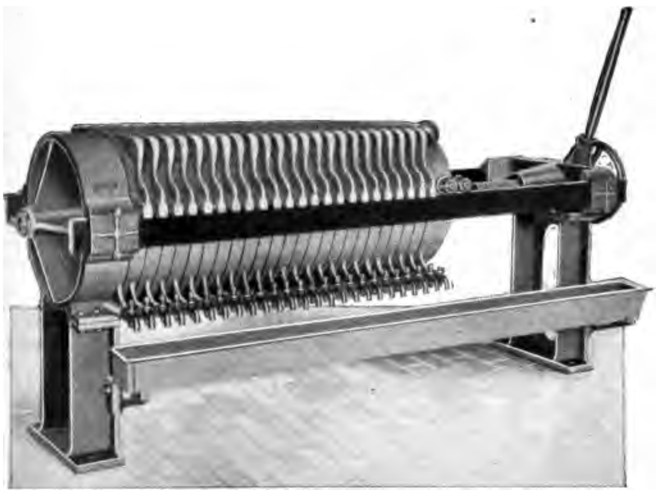
The yellow oil is run into the tank, where air is blown through it to remove the moisture, while at the same time it is heated to a temperature of 190° to 210°. By this time all the moisture is removed and the Fuller's earth is added in sufficient quantity to accomplish the bleach. This mass is being agitated all the time the earth is added in order to thoroughly mix the mass. After having thoroughly incorporated the Fuller's earth, the contents are then pumped through the filter press, which is filled with numerous layers of cotton cloth of certain fineness and strength. As this is pumped through the press the Fuller's earth is caught and the oil is permitted to flow on through, now thoroughly divested of coloring matter.

FILTER PROCESS.

The modern filter press is an extended idea of the old bag filter—and a far more efficient one. In cottonseed oil refining it is used for the separation of suspended impurities and for the separation of Fuller's earth, which has been used in the decolorization of refined oil. It consists essentially of a number of cast iron plates, grooved in various ways to facilitate

egress of the oil through the filtering medium, which may be either cloth or paper, according to the material to be filtered. Closely woven duck is used for cottonseed oil. The plates are provided with an opening, which may be in either the center, circumference or corner, according as the plates are circular or square; also an outlet for the discharge of the filtered oil. The plates are covered with cloth hanging loosely, but made tight around the opening. The plates thus prepared are set in the frame of the press and the whole tightened. This is formed of a series of cloth-lined filtering chambers for the deposit of solid matter in layers or cake. The oil is pumped into the press and into each chamber through the opening in the plate and cloth and finds egress through the outlet in each plate.

As the filtration takes place on each side of the filtering chamber, the deposit forming is built up gradually. When the chamber is filled with the deposit the pumping is stopped and



FILTER PRESS.

the residue cleaned by blowing out with either steam or compressed air. The press is then opened up and the cake called "spent Fuller's earth" is removed and the cloths sent to the laundry to be washed.

GREATEST FIRE HAZARD.

It is in the decoloring process that the greatest fire hazard develops in a cotton oil refinery. The spent Fuller's earth and

the filter press cloths, if not properly cared for, might cause a fire. The spent earth is usually removed from the building and thrown away, as otherwise it would be likely to cause spontaneous combustion. The filter press cloths are removed from the refinery division as soon as they are taken from the press and taken to the laundry division of the plant. Here they are thoroughly washed and dried preparatory to reusing. Authorities disagree as to the danger of spontaneous combustion from soiled press cloths, but all agree that it is better to have them removed immediately to the laundry, which is usually cut off in a standard manner from the refinery division. If not dangerous from the standpoint of causing a fire, they at least, if permitted to accumulate in the refinery, furnish an excellent material to support combustion once it starts. In a recent discussion of the subject of oil refinery hazards by a prominent oil mill chemist, he asserted that soiled press cloths would never cause a fire, but that an imperfectly washed cloth might ignite spontaneously from the small film of oil left on the fibers of the cloth.

After having gone through the filter press, the oil is then run through a vat or machine through which steam is blown to deodorize it; from there it is run to vats, where oleo-stearine is mixed with it in varying proportions of 20 per cent. in some instances to as high as 30 per cent. in others. In some plants the oleo-stearine is replaced by cottonseed stearin. This makes a purely vegetable lard, preferred by some.

COMPOUND LARDS.

The oleo-stearine used in the manufacture of compound lards is a packing house product from beef fats, and really is that which is contended by some as being the indigestable residue. Its use in the manufacture of the lard compounds is largely that of a vehicle in the solidification of the lard.

Being an animal fat, it is very susceptible for use as a supporter of combustion and its presence in large quantities is viewed by underwriters with suspicion. Experience with the so-called animal grease risks has been unsatisfactory because of the fact that a fire once started is very difficult to extinguish. So it is natural that when animal fats are found in vegetable oil refineries they are viewed with disfavor.

From the mixing tank the compound is run into the agitator, which is really an open cylindrical tank of boiler iron, provided with radial arms fixed to a vertical revolving shaft. The tank is usually a double shell, through which cold water or brine circulates. The compound is stirred until it is almost solid and then drawn into the packages for shipping.

THE LARD ROLL.

In large refineries this agitating tank is replaced by a lard roll, which is cooled by chilled water or brine. Some plants have

two rolls, the first receiving the hot material from the mixing tanks in a thin stream upon its surface, where it is partly cooled by ice water circulating through its hollow interior. As the roll revolves the compound, now beginning to thicken, is taken off by a scraper and carried to the next roll by a screw conveyor, where it is completely chilled and again scraped off and carried to an agitator, where it is evenly worked up and then packed in pails, cans or tubs and sent to the cold storage department until ordered for shipment.

Other products of vegetable oil refineries may be briefly mentioned: Oleomargarine, butterine, winter oils, summer oils, cooking oils, olive oil substitutes, miners' oils.

The processes involved are similar in part to those in the manufacture of lard compounds, but not so extended. The hazards are somewhat similar, so there is no necessity of going into the processes peculiar to each product.

SPECIAL HAZARDS.

Briefly, then, aside from the common hazards, the principal special hazards of the main divisions of vegetable oil refineries handling cottonseed oil are:

(a) Spent or used Fuller's earth;
(b) Filter press cloths;
(c) Storage of oleo-stearine.
(d) Refrigeration

If properly safeguarded these can all be so restricted as to avoid any serious fire hazard by—

(a) Immediate removal of spent Fuller's earth from the building.

(b) Immediate removal of filter press cloths to the laundry in a separate fire division.

(c) Storage of stock of oleo-stearine in separate fire division or building.

(d) Usual safeguards with reference to storage of ammonia drums in separate building.

We thus remove or minimize the causative special hazards and to a large degree minimize the communicative hazards which have a tendency to support combustion once it is started.

With the safeguards and recommended precautions taken, an unsprinklered fire resistive constructed plant would be nearly as attractive as an ordinary brick constructed plant sprinklered.

INCIDENTAL DANGERS.

The incidental operations connected with cotton oil refining introduce hazards which might lead to losses. In preparing the products for shipment large quantities of containers must be provided. Some refineries buy the tin containers already made up, while others buy the blanks and manufacture their own cans and tin pails.

Where the tin cans and pails are manufactured at the refinery the work should be done in a separate fire section. It is true that there is very slight hazard in some of the sections of refineries where cans are made, and it is equally true that in some plants the hazards are not properly safeguarded. Only a small amount of soldering is done on a lard pail, as the joints are of the lap and crimp type. The soldering machinery should be safeguarded.

More or less coopering is done at every refinery. Barrels must be fitted up and made tight. The practice now is to parafine or glue the interior of the package so as to prevent the absorption of the lard by the wood. Care should be taken to see that the paraffine and glue pots are steam heated and the work done in a section cut off from the main plant. Often one finds this work being done in the warehouse section of the plant, where the packing materials and cooperage are kept. It is much better to have these operations in a separate building or fire section, so as to have a small amount of combustible stuff for the flames should a fire occur.

PRODUCTS AND BY-PRODUCTS OF COTTON.

Vast Possibilities for Expanding the Use of the South's Greatest Crop.

By Oscar A. Smith, Memphis, Tenn.

Probably no agricultural product is capable of being worked up into so many different valuable and useful substances as is the cotton plant. To the average person the only products of the cotton plant are cotton lint, oil, meal and hulls. These, however, only scratch the surface of the possibilities of development of products from the cotton plant.

The stalks which are now a waste and a source of great inconvenience in the cultivation of the soils where the plans are heavy may be used to make a pulp which is a splendid substitute for wood and other pulps in the manufacture of paper. So far this has not been used for anything but for wrapping papers. It is estimated that about 15,000,000 tons of stalks are grown each season in the cotton section, but a very small percentage of these stalks are put to any practical use at the present time.

CONSERVATION POSSIBILITIES.

It has been suggested that in the utmost conservation of the by-products of the South's staple crop the following products may be secured:

From seed cotton are secured fibre, seed, flue dust and motes.

From the flue dust is derived fibre, used for paper stock; from leaves, fertilizer; from grabots, foodstuff, and from sand, fertilizer.

From the motes are derived hulls, fibre and fertilizer.

From the fibre is secured yarn from which is made the following varieties: dyed, printed, mercerized, fancy and bronze; twine, sewing cotton, embroidery cotton, lace, pillow lace, crochet work, knitting, trimming, tapestry and cords. The cloth made from the fibre includes all kinds of cotton garments, imitation leather, tire fillings, cotton hose, and in many instances cotton is used as money or a medium of trade exchange by natives of foreign lands.

From the offal of the fibre is produced the waste used for plating machinery, felt cotton, batting and wadding of all kinds, medical gauze, cottonoid, salicylated cotton, medicated cotton and cellulose.

FOOD PRODUCTS

The seeds themselves produce the food products which are taking the place to-day of many other foodstuffs.

In some countries the by-product industry is more fully developed than in this country. They delint the seed completely and make an actual separation of the kernel from the hull in such a way that the resulting meal and flour are totally unmixed with lint, which makes the products easy to digest.

With the waste from the lint taken off the seed in the process of delinting are made battings of all kinds, wadding, paper stock and bases for guncotton, nitro-cellulose and other high explosives.

From the hulls come stock feed. From the cake is secured a rough meal which after being refined yields a flour which contains up to 60 per cent. of protein. This when mixed in a scientific manner with wheat flour makes a nutritious flour for bread, pastry and cakes.

The by-products and waste of the crushed cake are used in making fertilizer. The rough meal is used also as stock food.

From the crude oils comes a variety of food products of extremely valuable nature. These take the place of the scarcer and more expensive oils of commerce, such as the high-grade emulsions and the olive oils. The following products of crude oil are:

Deodorized oil, salad oil, cooking oil, conserving oil, C. S. emulsion, perfumed oil, camphor oil, phosphorized lactagol, church oil, shrine oil, sanctuary oil, anointing oil, condensed fat, margarin compound, ice cream (creamless), insulating oil, vulcanite oil, varnish, miner's oil, burning oil.

CRUDE OIL PRODUCTS.

The by-products of the crude oil are: Soap stock, from which is made resin soap, finish soap, castile soap, soft soap, all kinds of laundry soap and soap powder.

Another by-product is beta pitch, from which is made paint, imitation rubber, rubber roofing and linoleum. Another by-product is the raw oleo from which is made oleo and oleomargarine.

Raw stearine also comes from the crude oil, and from the raw stearine comes cooking stearine and candle fat.

Glycerine is another product, from which comes the refined glycerine and nitro-glycerine which is so highly explosive.

From the cellulose produced from the fibre is made the photo film and a non-explosive celluloid preparation which is used for windshields on autos and in such places where sheets of mica were formerly utilized, except where exposed to fire.

Collodion and zapon are also secured as a result of the treatment of the fibre of the cotton plant.

The stalks and roots produce vulcanite fibre, methyl alcohol, fertilizer, foodstuff, liquid medicine, paper stock, fibre ropes, fibre bags, wood flour.

From grabots, fertilizer, foodstuff, paper stock, hard rubber (imitation).

From leaves, tea, medicine, foodstuff.

From blossom, liquid medicine.

From roots, fibre and balsam.

From root bark, liquid medicine.

From the delinted seed hulls are secured pure cellulose and paper stock.

From the pure cellulose are derived the following: Pyroxlin, medicine, nitro-cellulose, art silk, art horsehair, art straw, cloth and fancy goods.

Cellit L., bronze yarn, brocade embroidery, drapery and fancy goods.

From cellitfolic, another product of the lint, come the kino or movie film, photo plates, glass (imitation) and fancy goods.

POPULAR PREJUDICES.

The digestibility of the cotton seed product has been a matter of discussion on the part of the public. There has been a decided prejudice until recently against the use of the cotton seed product for human food. The relative digestibility of oils and lard fats are:

Refined cotton seed oil, 93.37 per cent; olive oil, 88.81 per cent; peanut oil, 85.87 per cent; corn oil, 86.47 per cent; home-made lard (soft), 88.78 per cent; home-made lard (hard), 73.88 per cent; beef suet, 73.66 per cent.

Economy in using cotton oil as compared with other well-known cooking fats is indicated as follows:

Cotton seed oil at 40 cents per gallon, 10 cents buys 7,980 calories of heat units. At 50 cents, 10 cents buys 6,340 calories of heat units.

Olive oil at $2.50 per gallon, 10 cents buys 1,237 calories.

Butter at 30 cents, 10 cents buys 1,235 calories.

Lard at 10 cents gives 4,220 calories for 10 cents.

Lard compound at 8 cents produces 5,275 calories for 10 cents.

Economic conditions will force upon us the necessity for conservation and a realization that we must be more careful and more thrifty in getting all out of the products of the soil.

COTTON GINS.

Hazards are High—Good Housekeeping Essential—Great Scope of the Industry in the South.

By Oscar A. Smith, Memphis, Tenn.

Cotton gins are the nightmare of the underwriter handling Southern territory, for such companies as are accepting lines on this class. The class produces a good volume of premiums. And a likewise distressingly large loss ratio is usually the experience of the companies.

According to the latest statistics we are able to get, there were 24,626 cotton gins in operation in the cotton States in 1915. This does not include the gins operated in connection with oil mills; neither does it contemplate the gins operated as linters in the various oil mills.

INSURANCE VALUES.

The average insurance value of a cotton gin is about $3,750. Formerly the values were lower, but under present-day conditions they have increased.

The average rate on these cotton gins runs near 4 per cent., making the average premium charge each year $150. Taking the number of gins into consideration, one gets a premium of $3,693,900 per annum.

We have the statement of the Cotton Ginners' Association to the effect that one gin out of two hundred burns every year. This produces an average of 124 fires per year at an average insurance loss of $3,750 and an average cash value loss of $5,000.

ONE-STORY GIN SYSTEM.

Consequently the estimated insurance loss per annum amounts to $465,000 and the actual loss to $620,000.

Do you wonder why the companies continue to write the class after the experience enumerated? This experience does not run level, but varies. Some companies make money several years and then run to the wrong side of the ledger. Then they try to pick the winners—the ones that do not burn.

UNDERWRITING DIFFERENCES.

All underwriters handling the class have theories as to how money may be made. Some will not write a gin with a lien or mortgage on it. Others will not write gins valued below a certain amount. Others will not write a gin over five years old. None should be written when ten years old. All these theories have merit; but they all seem to lose sight of the fact that one vastly important and vital point has been overlooked.

TWO-STORY GIN SYSTEM.

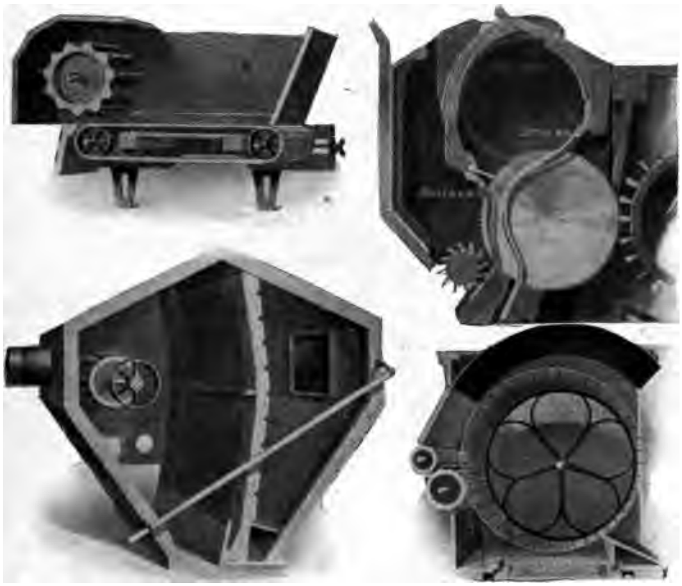
Good housekeeping is just as essential to profitable experience in cotton gin underwriting as it is in any other class—even more so than in some classes. If one has not given this proposition any consideration, let him go to the nearest cotton gin and make an examination with reference to this one item. If it is a two-story gin he will find the first floor littered with scrap bagging, motes, rubbish, lint and dust. The walls will likewise be covered with dust and lint, besides cobwebs will be in ample evidence. The next floor will show the walls and ceilings covered with lint, dust and cobwebs—all select fuel for a flash fire. The odds are that this plant has not been cleaned down for an entire season—sometimes two or more seasons. Do you doubt now the cause of this heavy loss experience?

How much better would a gin appear where it is shown that

at least once a week the walls, ceiling and floors are brushed down or blown down and cleaned out thoroughly. Does one hesitate to say that, otherwise, conditions being similar, the latter gin will prove the more profitable?

VARIOUS PROCESSES.

As now handled the cotton gin is divided into three divisions—the warehousing of the cotton containing the seeds (seed cotton), the gin room proper, where the separation is made and the



DETAILS OF 1. SIMPLE FEEDER. 2. HULLER ROLL BOX. 3. SEPARATOR BATTERY. 4. CONDENSER.

lint pressed into bales, and the warehousing of the seed after the lint has been removed.

The cotton house is divided into separate rooms or stalls so as to keep each customer's cotton separated. The seed cotton as it is picked from the balls in the field is either placed in large wagon bodies and carried to the gin at once or it is put into pens in the fields until several bales are gathered. During either process this cotton is used as a play spot for the picaninnies

and the result is that the cotton receives a full share of nails, buttons and stones to be carried to the cotton gin.

When the cotton arrives at the present-day gin it is unloaded by a pneumatic system into the feeder system of the gins or to the stalls for future attention.

The feeder systems vary in different plants. In some the pneumatic system is used entirely. In others a combination of pneumatic and endless spiked belt, which distributes the cotton to the different gin stands. As the cotton comes up through the pneumatic system it comes into a chamber of the system called a separator. Here the air pulled in with the cotton passes on through a screen and the cotton falls on revolving beaters and then down into the distributor. These beaters loosen up the cotton and separate the trash to a large degree. This same air passes on through the separator to the fan in the system, then into the seed distributing or blower system. This will be referred to later.

COMBINATION SYSTEM.

In the gins using a combination system the cotton falls from the separator upon an endless belt, which is provided with spikes and flights set every 12 to 18 inches. These carry the cotton along to the feeders set over each gin in the bank and so much cotton as is needed by that feeder is delivered and the excess is taken to the next feeder. If more is carried to the last feeder in the bank of gin stands, the excess is returned to the beginning and dropped upon the floor to be picked up later.

Coming now to the feeder, we find there are many types—some or simple construction having another slow-moving endless belt that drops the cotton slowly upon the roll that feeds the saws; others are more elaborate, providing a means of separating a part of the trash and dirt usually found in seed cotton coming to the gin. The cut shown is a transverse section of a feeder made by the Continental Gin Co. This machine rests upon the gin stand and comes up underneath the distributor system, forming a direct connection. The cotton is caught between two slowly revolving fluted rolls as shown and thrown upon the picker roller, which is studded with spikes, revolving rapidly and beating the cotton many times before it is taken off and thrown against the heavy curved wire screen. There it is beaten continuously by the picker roller until it passes over the entire screen. The dust and dirt drop down through the screen into the small conveyor and the cotton is then delivered into the gin roll.

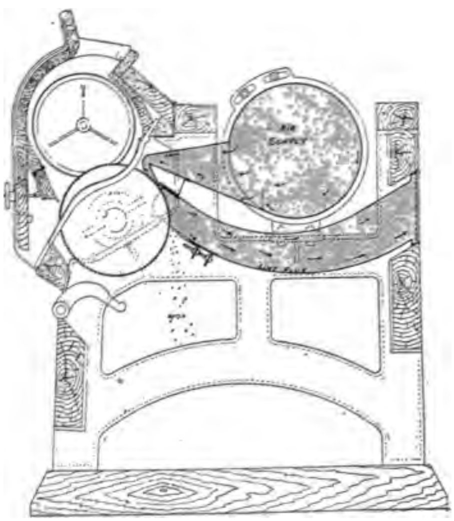
TYPES OF MACHINERY.

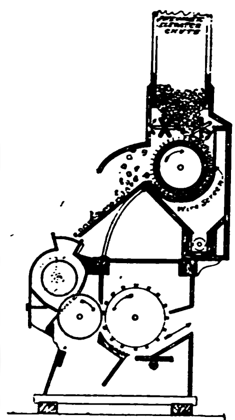
This gin roll is nothing more than the mass of cotton in contact with the saws and receives its rolling motion from the pull of the saw teeth on one point.

As will be noticed in the cut of the roll box, the huller attach-

ment is a space in front of the roll box. The seed cotton coming from the feeder drops into the huller box, where the spiked roller throws it against the saws. Any hulls (parts of bolls) are separated from the seed cotton and drop on down into the hull chute, while the seed cotton is pulled by the saws through the huller ribs into the roll box, where the lint is pulled from the seed by the saws and carried on between the cotton ribs into the brush box. The freed seeds are permitted to fall into the seed conveyor, where they are taken up by means of screw or belt conveyor and carried to the wagon or to the seed house. In some plants the entire system is a belt. In others it is entirely of screw conveyor type. In others the seeds are carried to a certain point by a belt or screw conveyor and there picked up by the air blast produced by the elevating system and blown through sheet iron piping to the wagon bin or to the seed house.

When the lint cotton reaches the brush box of the gin stand it is pulled off the saws by the rapidly revolving drum upon which are set rows of bristles or brushes. This drum, called a brush, revolves in the same direction of the saw teeth, but very much faster. The bristles travel 7,539 feet per minute on an 18-inch brush at 1,600 revolutions per minute. This high speed produces a draft, which carries the cotton along to the lint flue and thence to a condenser, where the air is separated from the



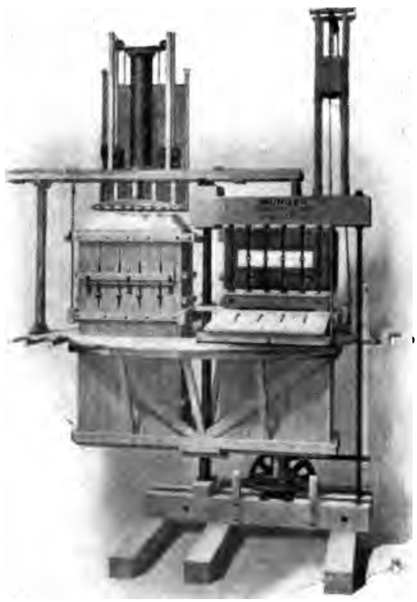


TRANSVERSE SECTION OF GIN AND FEEDER

flying lint, the air exhausting into the open air outside the building and the lint rolled out into the press box.

SEPARATING PROCESS.

Immature seeds, small enough to be pulled between the cotton ribs by the saws, are called motes. These are heavier than the lint. The brush revolving so rapidly strikes them, giving them a speed which overcomes the pull of the air carrying the lint. The result is they fall through an aperture in the brush box upon the floor or into a mote conveyor. With these motes may usually be found trash and bits of the cotton bolls cut up by the saws. These are a great source of dirt and trash and in the average gin are permitted to accumulate under the gin stand until they create quite a large amount of litter. These motes are now sold to mattress manufacturers, who regin them. Formerly they were permitted to accumulate around the premises, more often in the first story.



Double Box Press.

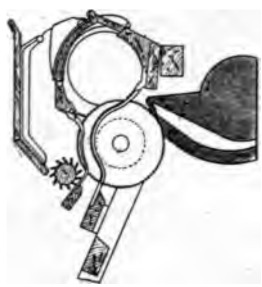
CAUSES OF FIRES.

Most ginners claim that the brush is the cause of the greatest number of gin fires. Hot bearings, cotton wrapped around the rapidly revolving brush shafts and cotton clogged at the end of the brush drums are the common sources of fires. Some ginners claim that three-fourths of the gin fires are caused by friction and that nearly always in the brush.

In addition to having been the cause of most of gin fires, the brush is also blamed for the increased expense of repairs from gin fires. These brush drums must be evenly balanced

or pounding and vibration ensues. If a fire ensues and the brush gets wet, it must come out of the stand and be thoroughly dried out and rebalanced before the machine can resume operations.

Some manufacturers of ginning outfits now make an air blast system, which eliminates the need for the brush box with its hazards. A slow-speed fan produces a blast, which is delivered at such an angle against the lint-laden saws as to pick the lint up and hurry it on through the lint flue into the condenser. This reduces the bearing surface in a gin stand to about 58 square inches as compared with 184 square inches in the brush gin, and consequently reduces the probability of friction fires. Some ginners state that while a fire may be expected for every 200 bales ginned on a brush gin outfit, there are any number of instances where 10,000 bales have been ginned by the new system without a single blaze. They even go further and say that with the new system matches, singly and by the box, have been thrown out without causing a fire. The writer has not verified the truth of these statements, but is giving it as a matter of report.



DOUBLE RIB HULLER ROLL BOX

WOODEN LINT FLUES.

The lint flue connecting the brush chamber with the condenser is usually made of iron. In fact, the experience has been that wood lint flues are very susceptible to fire damage as well as water damage and the insurance companies refuse to write a gin where wood lint flues are used.

A chance spark originating from metal or stone coming into contact with the saws is kicked on by the brush into the lint flue and to the condenser. Barely a second intervenes from the time the metal or stone is encountered until the fire is at the condenser. The usual practice is for the ginner to raise the roll box (also called the breast of the gin) from contact with the saws, thus shutting off the supply of lint. Another operator opens the straightway valve in the steam pipe in the lint flue and the pressman fights the fire at the condenser as it rolls into the press box. The best practice is to let the burning lint roll into the press box and then run the press block down on it. This compresses the cotton and removes the full opportunity to blaze. If handled properly there is small chance for the blaze

to be communicated to the building. Bad housekeeping here magnifies the danger of communicating the blaze to hanging lint, which when ignited gives a flash fire.

CONDENSERS.

The condenser heretofore referred to is a chamber containing a large wire drum revolving in such a way as to carry the lint which strikes it over to the doffing rollers, that condense the loose lint into a bat, which passes out between the doffing rollers into the lint chute to the press box. The air which entered with the lint passes on through the wire screen and exhausts through outlets into the open air. Such dust and dirt as have not already been separated from the lint are taken out by the escaping air.

The press is usually constructed of two chambers or boxes, arranged in such way as to receive cotton in one and partially packed while the other is being packed more closely and baled out.

Most gins now in operation have some sort of tramper, the tramping or packing block being actuated by friction, cog gearing, steam or compressed air. These are operated manually in most gins and really it is best that they should be, because of the supervision given by the packer attendant, thus detecting fires in their incipiency and combatting them successfully. Recent installations have automatic packers, leaving the packing attendant to do other work or eliminating him entirely. To our judgment this is not so desirable.

The compressing and tieing out of the bale is simple and no special hazards are attendant. This compression is done by hydraulic system sometimes and by screw and belt system or by steam. The more common system is the screw and belt system, which sometimes uses friction drive in connection with direct driving belt instead of shifting belts.

GIN HOUSES.

Formerly all gin houses were two stories tall. This was on account of the need for room for shafting and belting and also for press room. Then came a school of gin manufacturers who advocated the gin room of one story with a mezzanine for the press. This was considered by underwriters of sufficient improvement as to warrant a credit for the elimination of the shafting and belting hazard of the two-story class. The floors of these gins were usually made of concrete and the condition of the risk much improved. But the mezzanine was the means of permitting a certain amount of lint and dirt to accumulate in the inaccessible spaces. Then came one manufacturer of gins that arranged the press so as to eliminate the mezzanine entirely. This plan has been combined with the air blast system and it makes a very desirable risk from a housekeeping standpoint.

Underwriters have not seen the wisdom of this improvement sufficiently to require the actuaries to give concession in the estimates. This will come later, because the system makes a better fire risk. Cuts of the types of construction are sufficient to convince the careful underwriter that the latest plans are more desirable.

The handling and storing of the seed is not hazardous and very few fires originate in this section from causes inherent to the class.

RATING COTTON GINS.

The rating of cotton gins like that used in rating cotton oil mills and refineries is of long standing and inflexible. It does not recognize the important item of housekeeping. The cleanest and most carefully operated gin receives no more consideration than the slovenly maintained plant. The astounding thing to the keen analyst of fire hazards is that the actuaries handling the great majority of risks coming in this class have not recognized this need of flexibility. The time may come when the system of rating will be modified so as to give recognition to advantages of general care and cleanliness of a gin risk. Until that time comes and the gin operators are educated to good housekeeping companies writing the class may expect to have costly experience.

MEAT PACKING PLANTS.

Interesting and Complex Risks Involving Many Serious Hazards.

By Howard Campbell, Insurance Engineer, Kansas City, Mo.

Meat packing plants, or packing houses, as they are popularly called, are best known by their smells and their high prices, but as fire insurance risks they are among the most interesting and complex institutions presented by modern civilization. Intended primarily for the slaughtering and dressing of sheep, hogs and cattle for the market and consisting originally of one or two small buildings, with little equipment, they have grown to occupy many immense buildings, with auxiliary "shops" larger than many factories and of a surprising variety. As most of the auxiliary processes have been very thoroughly treated in previous "Live Articles" they will be mentioned here only as incidental to the whole plant. Enough matter will be left, however, to tax the capacity of a magazine article and this will be principally a suggestive article, to be completed only by actual experience in the plants themselves.

Before discussing the characteristic hazards of the packing houses proper let us mention and dismiss with only cursory treatment the auxiliary processes mentioned above. These vary with the plant, each having its own peculiarities, but include the following list:

Box factories,
Cooper shops,
Refrigerator car shops,
Carpenter and blacksmith shops,
Machine shops,
Electrical shops,
Paint shops,
Power houses, steam and electric,
Refrigerating plants,
Water pumping plants,
Water purifying plants,
Tin can manufacturing,
Printing and lithographing,
Stables,
Automobile garages,
Restaurants,
Laboratories,
Gas generating plants.

Most of these present little fire hazard, in themselves, but when we consider that they may have from five to ten electricians, ten to twenty carpenters. three to five blacksmiths, forty to fifty men and boys in the box shop, and other shops in proportion, these "shops" are seen to be important factors in

the total fire hazard. Some of the shops have large stocks of highly combustible material, like the box shop, stable or garage, and when they are located near, or even in, the buildings of the plant proper, they materially increase the conflagration hazard.

THE BOX FACTORIES,

which use very thin rough boards, with considerable coarse litter, were formerly one of the chief sources of worry, under the head of Auxiliary Buildings, but the introduction of automatic sprinklers and the increasing tendency to buy boxes ready made from box factories outside of the plant have almost eliminated that hazard.

THE CAR REPAIR SHOPS,

where the refrigerator cars are made and repaired, are usually, in the larger plants, situated at some distance from the main plant and operated as separate institutions, although under the same personal management. They present the well-known fire hazards of large woodworkers, metal workers and paint shops, aggravated frequently by large piles of lumber and the strings of cars, which are like so many frame rows, side by side. These plants are in most cases of frame construction, and as much of the work is done by hand wherever the cars are, it is difficult to segregate the hazards and to keep the scattered refuse cleaned up. The car shops seem to be considered side issues and not worthy of the best attention by the management of some plants, and it is surprising how many well-known precautions are neglected here. The inspector should double his thoroughness and look into all the corners.

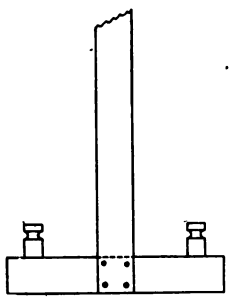
The watchman service of the main plant should always be extended to this shop, and especial attention should be paid to fire protection apparatus. In addition to the equipment in the buildings, fire hydrants, with an ample supply of hose, should be provided along the tracks where the cars are stored. Where there are more than two storage or repair tracks, over 1,000 feet long, hydrants and hose should be provided between every other pair of tracks. A spacing of 400 feet between hydrants in a single row, or 750 to 800 feet along each of two or more lines, with the hydrants "staggered" spaced, is usually ample. Each hydrant should have at least 500 feet of 2½-inch hose and a ¾-inch nozzle. The standard 1⅛-inch nozzle would waste water here and be harder to handle. Six-inch pipe and other standard equipment should be used, including a set of tools, such as axes, shovels and rope. The shovels are used in throwing dirt or sand onto grease or oil fires, and the rope is used with proper hooks for pulling away cars which the switch engines can not reach and for other purposes.

THE COOPER SHOPS

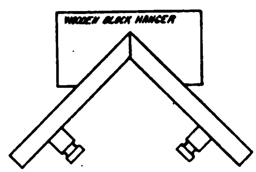
at packing houses are usually only re-coopering shops, where "tight" barrels are repaired. About the only fire hazard is the storage of the reeds which are split and inserted between the staves of leaky barrels. These are quite inflammable and should be limited to only a few bales if the shop is situated in an important building. Some times, but not very often, the barrels are painted, with the usual paint shop hazards. When new barrels are made the barrel heaters should be properly set on incombustible bases, with ample clearance to wood, and should have good brick chimneys. The shavings and litter should also be cleaned up well every day.

THE ELECTRICIANS' SHOP

deserves a few words. One fire hazard lies in the use of soldering furnaces, which are usually portable gasoline blow torches,



WOODEN TEE HANGER
FOR ELECTRIC WIRES



INVERTED WOODEN TROUGH
FOR ELECTRIC WIRES

and the supply of gasoline kept for them. There is no way of safeguarding these except care on the part of the men using them. Another hazard is the use of shellac and other inflammable varnish. Only a little is used, but the supply should be kept in approved metal paint cabinets. A frequent source of trouble is the dry box, where the armatures and field coils of motors are baked after being rewound and varnished. If made of metal, with gas or safely arranged electrical heat, the hazard is light; but if made of an old wooden box with some incandescent lamps dropped in, a home-made heat coil, or an open gas burner, with rubber tube connection or other bad condition, the fire hazard is obvious.

The storage of wire and other supplies is not hazardous, but the values are high and the stock is quite damageable.

These shops are a very essential part of packing houses, as even a small plant must have an electrician in its employ, who spends most of his time on electrical work. Many motors are used and artificial light is necessary everywhere. The moisture, steam, grease, salt and animal vapors make the wiring deteriorate rapidly and constant supervision is needed to keep it from becoming hazardous, both to life and to property. Some parts have to be renewed about once a year. Various schemes are used to combat the unfavorable conditions and each plant's man thinks his plan the best. This is a large enough subject for an article by itself and only a few points can be mentioned here.

Moisture is troublesome, by itself, principally in the switch and fuse cabinets, where the exposed metal parts are attacked by electrolytic corrosion. That is overcome to a large extent by using moisture-proof steel or cast iron boxes, or by using moisture-resistive boxes, made of wood heavily painted, lined with asbestos board or Transite, and kept dry by a carbon filament incandescent lamp left burning in it at all times. The box is set on knobs which hold it away from the damp wall. Varnishing the exposed current-carrying parts with shellac or lacquer often checks the corrosion.

Moisture and salt attack everything, copper, rubber, braiding, insulator screws and even the wooden supports. Asphaltum paint applied hot is the only thing that will protect against salt, and even that gives way in time. Inverted wooden troughs, or Tee hangers, as shown in the illustrations, have been successfully used to delay the action of the salt, but it is only a delay. The supports last much longer if heated to drive out all moisture, and then, while still very hot, dipped in hot asphaltum.

Iron conduit, galvanized or Sherardized, then painted with hot asphaltum paint, especially on the pipe joints, with the outlet boxes filled with melted paraffine, has been successfully used. The wax filling in the boxes is especially needed where the conduit passes from a cold to a warm room, as it prevents the circulation of the air and the resulting condensation of moisture in the pipe. Where the boxes are not so filled, holes should be drilled in all low points and in the bottoms of all switch boxes for drainage.

All sockets should be of a waterproof type, and experience has shown the superiority of composition or moulded mica sockets over porcelain ones, the latter being too easily broken. One point which should be closely observed is that the pendant wires should be made of stranded wire. Solid wires break off as a result of being moved back and forth. The joints at the drops, as well as all other joints, should be well made, soldered, taped with pure rubber tape and friction tape and then painted with an insulating paint, which makes them waterproof. This

is especially necessary where direct current is needed, as electrolysis is much worse than with alternating current.

Other small shops, such as carpenter, blacksmith, paint shop and pipe shops, present the usual hazards of litter, oily waste, storage of combustible materials, power, heat and light.

THE BOILER. ENGINE AND DYNAMO HOUSE,

usually known as the power house, presents the usual hazards of such plants. It should be built of fireproof construction, well cut off from other buildings, as the fire pumps, water supply pumps, steam jets, refrigerating machinery and other indispensable apparatus all depend on this section for power, if they are not located there themselves. They are essential to the operation and protection of all other parts of the plant and a small loss there would result in heavy loss elsewhere, through the loss of refrigeration or water, or the spoiling of partly prepared products. The duplication of power plants is highly advisable, as it minimizes the chance of complete shutdown.

THE REFRIGERATING PLANT

presents little, if any, direct fire hazard, but has four points of interest to us. These are the explosion hazard, the suffocating effect of the gas, the insulation of the cold storage rooms and the consequential damage feature. Refrigeration is effected by the compression, cooling and expansion of anhydrous ammonia, in most plants. This is received in a liquid form in steel drums. These drums when heated by a fire explode violently and greatly increase the damage. In one case coming under the writer's attention a comparatively small fire was well under control when the ammonia plant blew up, and not only scattered the fire, but tore down some floors and partitions, thus exposing a large mass of excellent fuel, and the plant was a total loss. The spare drums should be stored outside of any important buildings and where they will be cool and easily removed. Fusible plugs are now used in the necks of the drums, which melt under fire heat and relieve dangerous pressures, but the gas is then inside, where it will hamper the firemen.

The entire ammonia plant, consisting of compressor, condensing coils, receiver or storage cylinder for the liquefied ammonia, and the expansion pipes, is subject to the explosion hazard. These systems can be easily equipped, however, with relief valves, dischargin to the outside of the building, which will not interfere with the normal operation of the system. These will relieve any dangerously excessive pressure and prevent explosions. It has been stated recently that there are certain mixtures of ammonia and air that are inherently explosive, but others say that impurities are needed to produce explosive mixtures.

AMMONIA GAS QUICKLY SUFFOCATES PERSONS

when released in a fairly tight room. That materially increases the seriousness of ammonia explosions or leaks, as the firemen may be unable to enter and fight the fire, or to rescue any injured or suffocated occupants. A smoke helmet, which enables one to enter a room full of suffocating gas or smoke, should be provided for use in all cold storage plants.

TO KEEP THE HEAT OUT OF COLD STORAGE ROOMS

it is necessary to insulate the walls with some filler or sheathing through which heat will travel very slowly. If pure cork board, or slabs made of granulated cork forced together under very heavy pressure, are used there is no fire hazard and the walls are not easily damaged by fire or water. Mineral wool is also fireproof, but absorbs water freely and packs together and is then a good conductor of heat.

Cork board with an asphaltum or other combustible binder is a good insulator, but will burn and spread fire readily. It is not damaged by water. There are patent insulating materials, the character of which can be ascertained either by making fire and water tests or by writing to the Underwriters' Laboratories, in Chicago, who have tested and reported on many of them. If the material absorbs water freely, or if it will smoulder, it is not a good kind for packing house use, although it might be very good for smaller coolers.

In small plants, especially the older ones, one occasionally finds wooden cooler partitions, filled with sawdust, or with unfilled air spaces. These will carry fire freely. Fire will smoulder in the sawdust for weeks and break out again and again, after having apparently been extinguished. There is said to be some danger of spontaneous ignition in wet sawdust, but it appears to be quite remote. Such fires could probably be traced to greasy clothes or other foreign material in the sawdust.

The cold storage rooms in packing houses are so large that special means must be taken to see that the cold air circulates and that all parts are thoroughly cooled and that none are too cold. In some plants the air is blown over coils of pipe in which chilled brine circulates and then to the coolers through galvanized ducts, one for each floor, with several openings on each floor. These add but little to the hazard of the plant. In others the air is cooled on one of the upper floors and circulates by gravity. The cooled air flows down through apertures near the center line of each floor and the warm air rises through shafts along the outer walls. Fire in such a building could quickly spread from floor to floor, and this system should not be used if it can be avoided. In other rooms each has its own set of chilled brine pipes, on the ceiling. Those present no fire hazard. When the gravity system mentioned above is used

the air is usually cooled by means of the "sheet system." Large cotton sheets are hung in the loft, or top story, over iron pans; the chilled brine is dripped onto them from pipes at the tops and wets them thoroughly. That chills the air in the loft, which falls by gravity through the air ducts. These sheets appear to present very good fuel, especially when they have not been used for a day or so and are dry. The sheet rooms are always dripping wet and the electric wiring is usually in bad order, so that there is a good chance for fire to start there.

Consequential damage is the indirect loss from fire in cold storage plants where, although there may be no direct fire loss to the stock in storage, the fire may disable the refrigerating system and allow the stock to get warm and spoil. The system can be disabled by fire in the power house or ice machine room, or by fire in a building through which the brine or ammonia pipes pass. The most effective protection against loss of this kind is to provide two or more refrigerating machine plants, and to run the refrigerating pipes underground to all buildings, or outside of all other buildings, if above ground.

PUMP HOUSES. AND WATER SOFTENING AND FILTERING PLANTS

present no unusual fire hazards. The chemicals used are all non-hazardous, and little, if any, heat is required, all that is needed being to keep the temperature above freezing. The chemicals include copperas (iron sulphate), crude alum (aluminum sulphate), chloride of lime (hypochlorite, or "bleach"), slacked lime and sodium carbonate. Defective electric wiring is about the only probable fire hazard. These plants should be located well away from other buildings and should be as nearly fireproof as possible. Shingle roofs should never be used on the wells.

STABLES AND AUTOMOBILE GARAGES

present the usual hazards of such risks, modified usually by the excellent care given them in packing houses. The horses used are of selected breeds in the larger plants and many keep teams for show purposes. It is well to make frequent inspections, however, as even these stables are sometimes neglected.

RESTAURANTS

are provided for both the office force and for the other employees. They need attention to the usual fire hazards of proper clearance to wood underneath the range and other heaters and at the smoke pipe and ventilating pipe. The latter get very greasy inside and if not starting a fire themselves will spread fire rapidly. The employees' restaurant is apt to be located in an out-of-the-way place, where it may be neglected in the general care of the plant. Attention should be given to the proper disposal of the greasy refuse and also to the possible accumula-

tion of soiled clothing. Temporary arrangements of coffee urns, hot plates and other small lunch or coffee heaters are a frequent source of trouble. They are "only temporary," but somehow they get left in, and are still there on the inspector's next visit unless he includes them in his report to the general office.

LABORATORIES

are maintained at some of the larger plants for testing various food products, especially the vegetable oils and other adulterants. No high temperatures are used and no hazardous chemicals as a rule, except small quantities of ether and other volatile solvents and a small amount of acid. The rubber tubes on the Bunsen burners present an unavoidable hazard, but as there is constant human supervision and they are used on slate or other incombustible tables the hazard is light. The ventilating hoods, unless made of incombustible material, such as slate or hard asbestos board, are quite hazardous. The wood becomes very dry and easily ignites from a spark or other unusual heat.

PRINTING AND LITHOGRAPHING

are a part of the tin can process, and other labels and stationery are also gotten out. Attention should be given to the disposal of oily waste and rags soaked with oil or printers' ink. Safety cans should be provided for all gasoline, etc., and not over one day's supply should be allowed in the building at one time. Wooden floors under large presses should be protected with sheet iron, to keep oil, etc., from the floor and make it easier to clean up. Sometimes the painting or lacquering of tin cans is an attendant hazard. Naphtha paint or lacquers dissolved in amyl acetate, both of which are very volatile and combustible. Not over one day's supply should be allowed in the building at one time, and open lights or stoves should be prohibited. Some of the cans are baked, after being painted or lithographed, and the bake ovens, or enameling ovens, are hazardous if not built entirely of metal or other fireproof material, and properly ventilated. The method of heating should also be investigated.

TIN CAN MANUFACTURING

presents a few hazards, although the main part of the work is not hazardous. The painting described above and the soldering are the principal ones. Gas is used for the soldering furnaces and if the latter are mounted on iron stands there is little fire hazard. If wooden benches are used, with no adequate protection, the hazard is severe. The wood and paper crating on the better grades of tin sometimes litter up the factories, but that is careless and unnecessary. The tin stock is subject to heavy damage by fire and water and should be given immediate attention after a fire to see that it is thoroughly dried, so that it will not rust. The best grades sometimes have tissue paper

between them to protect the polished surfaces. That absorbs water freely and if not quickly removed will, in drying, make the sheets of tin stick together and render them worthless. All sheet metal stocks should be piled on skids, or racks which will hold them at least four inches above the floor, so that water on the floor will not damage them.

GAS IS MANUFACTURED AT SOME PLANTS, where city or natural gas is not available or is too high priced. Several kinds of plants are used, including gasoline vaporizers, oil and water gas, coal gas and acetylene. There are usually small plants detached from the main buildings and a full description is unnecessary here. The gas is used in the tin shops, can factory, laboratories, stereotyping furnaces, for small heaters in offices in cold storage rooms, for singeing hogs, after scraping them, for branding hams and bacon and sometimes for rendering or in the fertilizer furnaces.

About the only thing the fire insurance man needs to do in this connection is to see that each building has a separate outside gas cutoff readily accessible and that the gas-heated devices are safely set.

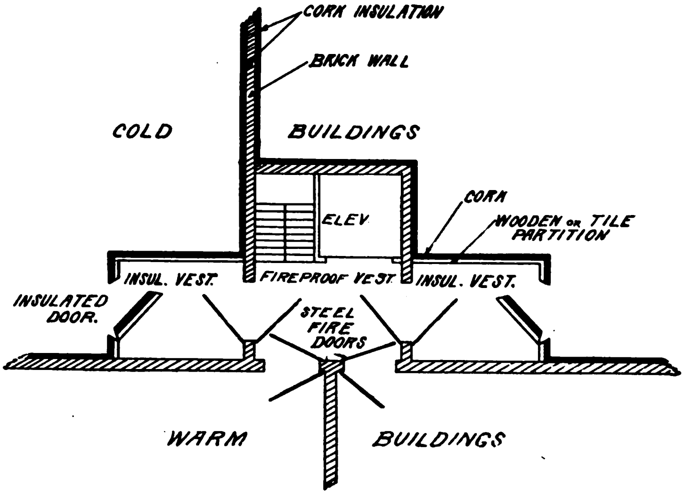
THE PROTECTION OF COMMUNICATING OPENINGS in division fire walls, which is a hard problem in any case, is exceedingly difficult in packing houses. Moisture, salt, careless workmen and mechanical difficulties require a great deal of ingenuity in the original installations, as well as the best and heaviest materials, and make frequent inspections and repairs necessary.

The only type of door that will stand up under packing house use is the 3-16-inch boiler plate door, with heavy angle iron frame, and even those have to be protected with a heavy coat of hot asphaltum paint and repainted frequently to prevent their rusting out in a short time. These heavy doors will also stand being slammed open and shut and being bumped into by the heavy trucks, which is not the case with light steel doors and much less with tin-clad doors. Corrugated or slatted doors are impractical, as it is impossible to paint and repaint all the exposed surfaces.

Insulated division fire walls, with communicating openings, present one of the hardest problems. Fire doors will conduct heat sufficiently to waste a great deal of refrigeration. Even the bolts carrying the rails and hinges will cause noticeable loss. In some cases a "plug" door, as the insulated cooler doors are called, is bolted to the inner face of the fire door. That can be done where only one door is required, but not where a door is needed on each side of the wall. In that case an inner vestibule, with insulated walls and doors, is used, with ordinary fire doors at the division wall. A diagram of such a vestibule

is shown in the illustrations. In addition to improving the fire cutoff, such a vestibule reduces the loss of refrigeration by preventing direct exposure to the outer, warmer air. The loss of floor space is more than compensated for by these two features, except in small plants.

The conveyor rails on which the meat is carried from building to building present another hard problem. These interfere with the operation of the fire doors, and it is practically impossible to secure a complete and reliable cutoff. Fairly good protection is obtained in some cases by notching the corners of the doors and providing one or more small flaps of 3-16-inch



INSULATING AND FIREPROOF VESTIBULES.

steel plate, which will automatically drop over the opening left for the rail when the door is closed. Each case needs special attention and the master mechanic at each plant has his own ideas, which are usually helpful, at least. The set rules for ordinary practice must often be "forgotten" in packing houses and the equipment approved which appears best for the case in hand.

All doors, regardless of the type or other conditions, should be inspected at least once in two weeks, and as a check on the *inspections* the watchman should be required to report any

trouble he finds and to make a written report once a month on all doors. The troubles most frequently found are:

(a) Bent latch bars, so that the door will not close tight or stay shut.

(b) Doors "warped," so that they will not close smoke-tight at the top or bottom.

(c) Rusty hinges, which make the doors close hard. It is easier for the employees to leave such doors open than to close them each time they pass through.

(d) Wooden sills, or approach blocks, are often left in the openings. They should not be permitted in the opening itself and should be so arranged that they will not interfere with the operation of the door. The sills should be raised so that water will not stand in the doorway. as that encourages the use of a wooden sill to keep the floor of the opening dry.

(e) Sawdust, paper, spilled fertilizer and other litter often block the doors, especially sliding doors. It should be cleaned up every night before the employees leave.

(f) Automatic attachments out of order. This is a rare trouble in packing houses, as "there ain't no such animal." They would last just about a month.

Vestibules or "fire towers" with double fire doors on the openings into the buildings form the most complete cutoff where communication openings are required. They also provide a vantage point for the firemen and a safe exit for the employees, besides helping as mentioned above, to conserve the refrigeration. They consist essentially of brick towers, with concrete floors, in which are located the stairs and elevators and sometimes standpipes and fire hose. In some cases. especially in cold storage houses, they are located in the center of a group of buildings, where they are not directly accessible from outdoors. In others they are placed at the outer end of division walls, with fire doors and windows to the outside on each floor level. That is much better for fire fighting purposes.

While the auxiliary features already described are important, the purpose of this article is to discuss the fire hazards of packing houses proper. The auxiliary processes have been treated first to show the complicated nature of these risks and that they touch almost every phase of fire hazard. We will now attempt to discuss in some detail the peculiar hazards found only in these risks.

THE STOCK PENS

at packing houses are usually quite small, as the plants buy only such animals as are needed for one or two days' killing from the general stock yards which supply several plants and the general market. The pens at the plants are usually built one above the other to save space and have open wooden sides,

interior fences and runways from floor to floor and to other buildings. The fences burn freely and by obstructing the passageways hamper the work of the firemen. Wooden floors of open joist construction are the rule and add to the available fuel. In the newer plants concrete has greatly reduced the hazard of the pens. Little feeding and bedding is done here, but there is nevertheless a considerable amount of hay in most cases. When a fire gets a start in such a risk and the animals get stampeded it takes hard work and the level heads of well-trained firemen to prevent serious loss. Barrels and buckets should be distributed freely for "first aid" use and hydrants with short lengths of fire hose should be provided in all the main runways and on the roofs. Red posts and red lights are a big help in locating the hose quickly. This hose should be reserved for fire defense only. Automatic sprinklers can be used to good advantage in these buildings, but need special protection against injury on account of the low ceilings.

ELECTRIC PRODS

are used at many plants for driving the cattle. These are poles with exposed electrical terminals on the ends. Their use prevents bruises and also makes the cattle move faster. There would seem to be some fire hazard in the long cords needed, if they are not changed frequently.

THE CATTLE-KILLING BEDS OR ABBATOIRS

present little fire hazard, except the open construction of the buildings. Where hogs are killed they are dropped almost immediately into vats of hot water and then carried up through a "scraper" which removes the hair. There is the slight hazard of steam pipes and the rooms are usually greasy and will burn freely, in spite of their being wet at all times. The removal of the entrails follows, usually in the same building, if not in the same room. They are dropped, as soon as they have been examined by the government inspector, into a conveyor leading to the tank house and there is remarkably little grease and disorder in these rooms. The torches used for singeing off any hair left by the scrapers are not hazardous if carefully handled and always turned off when not in use. If turned low and hung up on wooden posts the hazard is obvious.

THE CONVEYORS

on which the carcasses are carried from room to room start here. As described in the section on fire doors, these greatly increase the difficulty of separating the buildings where they pass through division fire walls.

THE CUTTING ROOMS,

where the meat is cut up into sizes for the market and the odd bony pieces are cleaned, at least partly, present little

fire hazard. Care should be given to see that soiled clothing and rags and the litter from the cutting tables are cleaned up, as there is a distinct liability to spontaneous ignition in them. The government inspectors take pretty good care of such conditions now, but one occasionally finds some neglect. These rooms are refrigerated, usually with brine, which is not hazardous, but the foreman's office and scale room are heated. These need particular attention. Oil stoves are probably the most common means, but electric heaters are often used. Either is safe when properly constructed and used right. But home-made heaters, or approved heaters set too close to wood, or without guards to keep off paper, clothing, etc., which is carelessly thrown onto them are dangerous. If substantial guards are not incorporated in the heater itself heavy wire screens with strong frames should be provided.

The chutes from the cutting floor to the other floors require considerable ingenuity to protect them so that they will not let fire pass up through them. They are different in each plant and each requires special treatment.

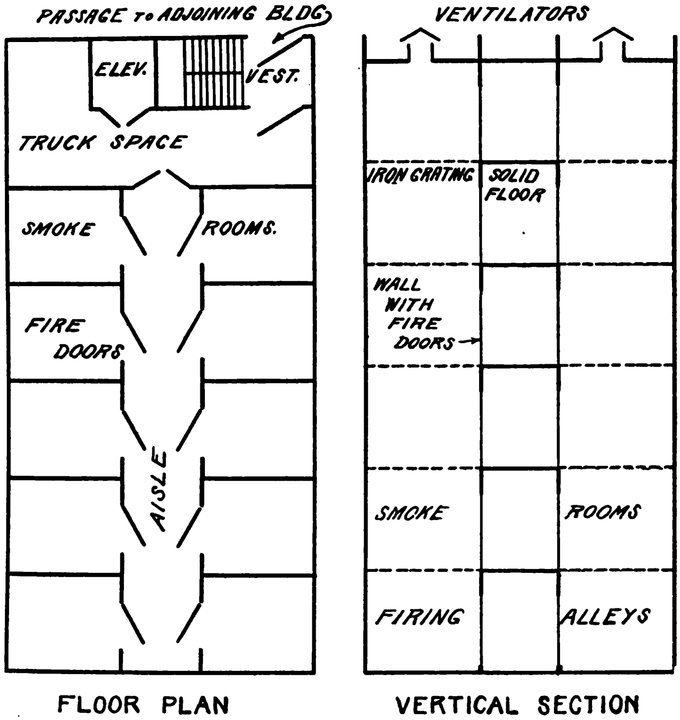
COOLERS AND CHILL ROOMS,

aside from the combustibility of the stock, which is present in all parts of packing houses, present only indirect fire hazards. They are used for the preliminary cooling of the freshly killed meat and the introduction of the warm, moist carcasses into the cold air results in a heavy fog which hangs on for several hours. The walls and ceilings drip with moisture and then after the meat is chilled the fog passes away and the wood dries out a little. As a result the wood rots quickly and the nails and other metal rust out quickly. That lets the electric wiring and the piping of the rooms sag and sometimes fall. The moisture, and especially the vapors from the warm meat, attack the wiring at the joints and other connections, in the sockets, and wherever else the copper is exposed to even the slightest degree. Within a few months after wiring has been installed in a chill room it is often in dangerous condition. For that reason frequent inspections should be made and the slightest trouble noted and corrected.

The rapid deterioration of cooler buildings, and of all their equipment, should be carefully considered in adjusting losses or in reporting values. The fire doors especially suffer, and unless well brushed off with a steel brush occasionally and thoroughly painted with asphaltum paint they may be found to be worthless as fire stops.

The use of concrete floors in the newer plants, insulated with cork board and then finished with a heavy coat of cement, which is impervious to moisture, has done much to lessen the deterioration of these buldings.

One would think that wet buildings like these would be immune from fire loss, but experience has shown that fire can start in them and will spread rapidly. The numerous wooden partitions and doors to the "hanging rooms" quickly dry out, ahead of the firė, and furnish excellent fuel.



SMOKE HOUSE

Attempts have been made to provide ventilating ducts for the escape of the fog. If at the roof line these act just opposite to chimneys, as the cold air settles down. That draws in warm air. The moisture in that is congealed and adds to the fog. If the vents are at the floor there is an excessive loss of refrigeration through the escape of the cold air. Usually no attempt is made to remedy the condition.

COLD STORAGE ROOMS

of various kinds form a large part of packing house values. The coolers for the freshly killed meat have been described. The rooms in which the meat is hung simply for preservation present no particular fire hazard, other than their construction, as described under refrigerating plants above, and the combustibility of the meats themselves.

FREEZERS.

are rooms cooled by the direct expansion of ammonia. They are usually parts of a cold storage building and seldom occupy an entire building. They are used to cool hams and bacon to a point where the action of the salt and "pickle" is checked and also to soften the tissues of other meats, such as liver and the finer cuts of beef. Mincemeat is often frozen to make it tender. The temperatures here often drop to five degrees below zero, Fahrenheit. The direct expansion of ammonia introduces the explosion and suffocation hazards described under refrigeration. Frost and ice gather on the pipes, wires, etc., in these rooms in heavy coats. As long as it is frozen and undisturbed it does no harm, but when it is removed mechanically, or by letting steam into the pipes, or by letting the rooms get warm, the falling ice often pulls the electric wiring down. It may simply strain them and loosen up the joints and connections. The poor connections are then ready to heat up and make trouble. For that reason conduit wiring installed properly by experienced packing house electricians should always be used.

PICKLE CELLARS

are the refrigerated rooms where the meat is soaked in a solution of salt, saltpeter, sugar and other ingredients to preserve and flavor it. The exact composition of the "pickle" is jealously guarded by each plant, as this has much to do with the final quality of their product. These rooms are always wet and water stands in puddles on the floors. They do not seem to deteriorate as rapidly as the chill rooms, where the wood has a chance to dry out occasionally. The empty saltpeter (sodium nitrate) bags may cause trouble if not removed and burned at once, when emptied, as they are subject to spontaneous ignition. Only small quantities, comparatively, are used, however, and this appears to be a rather remote hazard.

DRY SALT CELLARS,

where the meat is simply salted heavily and piled up, are also wet places, as are hide cellars, where the hides and pelts are dry salt cured. They present the same hazard, or lack of hazard, as pickle cellars. They are subject to excessive water damage, especially the hides, as fresh water removes the salt

and decay starts almost immediately. Cellars, by the way, in packing houses may be on any floor level and are seldom below grade level.

Although there seems to be on a casual inspection very little chance for fire to start in cold storage houses, fires have caused serious loss. The immense values and the low rates on these sections make thorough and frequent inspections highly advisable. Attention should be given especially to the separation of the values from other sections by fire walls with good fire doors, vestibules, etc., which are described more fully elsewhere in this article.

SAUSAGE MANUFACTURING

is not hazardous except for the unusually fat meat used, the attendant hazards of cooking and smoking and the usual hazards of grease and soiled clothing. Occasionally one finds a mill for grinding the cereals which are used to give body to some of the cheaper sausages. These have the usual hazards of hot bearings, high speed, sparks and dust, but are usually small and negligible. The smoking of the sausages is usually done in a separate building, as described below.

CASINGS CLEANING

is a preliminary process to sausage making. The intestines are cleaned and sorted by hand and then scraped in special machines, so that they are perfectly clean when taken to the sausage machines. All this work is done cold and wet, and although the odors are among the worst at the plants, there seems to be little fire hazard. The deterioration of buildings and equipment is very rapid and the open type electric wiring soon becomes dangerous unless repaired frequently.

SMOKE HOUSES

present one of the few serious causative fire hazards of packing houses. The meat is hung by strings in compartments over smouldering wood or cob fires. Hardwood, usually hickory, is used, so that there is little danger from the fire itself. The meats are very fat, however, and if the fire gets a little too hot, so that the fat drips, or if a piece of meat falls onto the fire, or if the greasy soot on the walls catches on fire, or anything else causes the fire to flare up, the smoke house quickly becomes a roaring furnace. They are usually from three to five stories high, as shown in the diagrams, and the draught is intense. Heavy brick walls with fire doors at each floor, large ventilators in the roof (kept at least six feet from any other roof or structure) and a concrete roof are needed to confine the fire to the smoke house after it has started. Two-inch live-steam jets, used early enough, would probably extinguish the vre. Small jets would merely fan the flames.

The sill on the first story, or basement, where the fire is

made, should be raised about six inches, to keep the burning fats from running out and sprading the fire. The "floors" of the upper stories, where the meat is hung, should be made of heavy iron grating or steel rods. These will catch any loose meat and keep it from falling into the fire, provide a firm floor for the workmen and still let the smoke pass through.

The wood and cobs used for fuel are usually stored at one end of the "firing alley," or in an adjoining room. If kept clear of litter, these should not add greatly to the general fire hazard. One good feature of the firing alleys is that by stepping into the fire room one can rid himself of the odors he has absorbed in the fertilizer and other malodorous departments.

THE LARD RENDERING HOUSE

and the tankage rendering and boiling house, or the tank house, as it is commonly called, differ principally in the matter of cleanliness and the nature of the stock handled. They both use high pressure steam and are very greasy, but the tank house stock is the refuse from other departments, including the carcasses of condemned animals, and it is handled more carelessly and is spattered around more. It is also more bulky an dirregular in consistency, so that it is harder to handle. The filling floor and the dump are both dirtier here. That encourages the spread of fire, and tank or rendering house fires are feared. Proper clearance to wood is essential at all steam pipes and also at the floors through which the tanks pass. The fire hazard of steam-heated devices too close to wood is well established at packing houses. Soiled clothing and the rags which are used freely here for wiping up should be especially well cared for, as the grease and heat invite rapid decomposition and oxidation of the fats, which would cause spontaneous ignition in a short time. The electric wiring suffers greatly here from the effect of the hot grease on the rubber insulation and also from the refuse which spatters onto the wires at the dump. Conduit should always be used here.

THE LARD REFINERY AND COMPOUNDING HOUSE

is usually in a separate building from the lard rendering house. Here the crude and refined lard, tallow and vegetable oils, like cottonseed oil, olive oil, palm oil and others, are stored, in steel tanks, often very large. These present little causative hazard, but in case of bad fires from other causes they add greatly to the intensity and duration of the fire and make it hard to confine to one building. The hot burning oils run through closed doors, easily spreading fire as they go, and water will not quench it. The plant is fortunate which can have these tanks in a separate building, used for no other purpose, or, better still, can locate them outdoors. The door sills of all communicating doors should be raised about one foot above the floor

levels to confine the oil. Vestibules would be very effective here, but as they impede traffic somewhat they are very seldom used. Steam jets in the tanks would be very effective means of controlling fires starting in the tanks themselves, but as fires seldom or never start in the tanks, this would seem to be needless equipment. The jets would not be effective on fires outside of the tanks.

Th refining of lard presents but little causative fire hazard, but the extremely greasy nature of the risk and the highly combustible stock make the lard refinery one of the danger spots of these plants. The crude lard from the rendering tanks is heated slightly and pressed in long presses, with cotton cloths, which drip with oil all over . The floors and walls of the press rooms are unavoidably very greasy. Usually the presses extend through one or more floors, thus aggravating the already serious fire hazard.

The pressed lard is sometimes run directly into cans and removed, but the better grades are sometimes filtered and then flaked and whitened by running them through "lard rolls." These have large iron rolls which run partly immersed in the melted lard. They are cooled by brine inside, which chills the lard suddenly and makes it flaky or granular. A scraper removes the chilled lard, which is made snowy white by the process.

COMPOUNDING

is the blending of several kinds of oils, animal or vegetable, to either frankly adulterate lard, or to make lard substitutes. Cottonseed oil or beef tallow are used chiefly. The process consists usually of heating and mixing the oils in large wooden or steel vats and then whitening them in the lard rolls. The exact nature of these processes is guarded closely, as they are trade secrets, but they are substantially as above. The fire hazard is the same as that of the lard refinery, of which this is a part.

An attendant hazard of these greasy risks is the deteriorating offect of the grease on the rubber insulation of electric wires. The portable cords which are necessary for use in cleaning the tanks and in handling the numerous valves, etc., suffer severely and unless replaced very frequently soon become soft and a very slight injury will expose the copper. No cord has yet been put on the marke twhich will stand up in these risks. One has been designed which under trial use at the suggestion of the writer was uninjured after five or six years' use, but the cost was said by the manufacturers to be too great.

THE OLEOMARGARINE AND BUTTER MANUFACTURING BUILDINGS,

or creameries, are perhaps the cleanest parts of packing houses. They present little causative fire hazard, if the rendering of the fats is not done here. Like that if lard refineries, the stock

is highly combustible, but there is less of it, and as it has a higher melting point and is more solid at ordinary temperatures, it is not so greasy as lard and cottonseed oil. The steam pipes present the same hazard as do oily rags, etc.

The melted tallow is run into portable wooden vats, which are kept scrupulously clean, and stored in a warm room for several hours and allowed to cool slowly, being stirred up occasionally by hand. The stearine or solid, waxy part of the tallow rises to the top and is removed and pressed to remove all of the oil. It is then pressed into cakes and sold to candle manufacturers and other industries. The oil, or oleo, is reheated and refined and then mixed with other oils and churned in buttermilk to give it a butter-like flavor. The only apparent fire hazard in all of this is the presence of the highly combustible stock, the comparatively slight amount of grease on the floors and walls, and the slight hazard of steam heat. Electric motors sometimes give trouble also. A small amount of butter is usually made, simply to furnish the buttermilk, although the milk is sometimes soured artificially, which permits much more accurate control of the flavor.

Where butter is made and sold as butter the government requires the creamery and the oleo house to be separated in such a way that stock can not pass directly from one to the other, but must be carried out of doors. The locked doors sometimes impede firemen, but a few blows from an ax soon remedy that.

GLUE IS A BY-PRODUCT

at most plants. It is made by boiling the scrap of various kinds, carefully selected, and drying the "stick," as the liquor is called. The drying ovens are quite large, often occupying the entire area of one floor, and are steam-heated. If built of incombustible material the fire hazard is light, except that the stock is combustible. Occasionally the large fans which handle the hot air get out of order and make trouble. Sometimes a little wood is used inadvertently in the contruction of the fan housing and the constant draught of moist hot air causes a species of spontaneous ignition. These fires are usually severe and spread rapidly, but as the most of the building is rather wet and there is little fat meat present they should be easily handled.

DRIED BLOOD AND BEEF EXTRACT

are treated somewhat similarly to glue, from the standpoint of fire hazard, but on much smaller scales. The dried blood, which is used both as fertilizer and for medicinal purposes, presents the hazard of spontaneous ignition in a marked degree if not kept pure and dry. It should not be allowed to remain in corners and under the machinery. There should always be a fire extinguisher in these rooms.

is made by drying and grinding the refuse and scrap from all parts of the plant, especially the solids and semi-solids or "tankage" left after the greases have been tried out in the lard and tankage rendering houses. This fluid mass is also known as "stick," and, in fact, the process is essentially the same as glue making, except in the details and results. The driers are fire-heated, instead of steam-heated, and are much smaller and are usually built of steel, cased in brick, with ample clearance to ceilings and walls. In small plants they are sometimes quite unsafe, especially where the tankage is only dried and shipped for final treatment to other plants. The dried tankage, which has been graded according to the nature of the fertilizer desired, is ground to a fine powder, ready for sale as fertilizer. This powder burns very freely. It is a disputed question whether the ground fertilizer is in itself subject to spontaneous ignition, the greater probability being that the fires attributed to that cause. which are quite frequent, are caused either by foreign material, such as greasy clothing, by too close proximity to steam pipes, or by smouldering fires started by sparks in the driers or grinding mills. When fires break out they are usually sudden and severe, on account of the fine dust which fills the air and settles on everything. The litter and sometimes filled or empty sacks are allowed to accumulate near fire doors and block them. This is one result of the class of labor which it is necessary to employ in these odoriferous risks.

Fertilizer factories are not "preferred risks," but the warehouses where sacked or bulk fertilizer is stored should not be hazardous, if the fertilizer has been allowed to stand for some time in the factory after it is ground, so that any smouldering fires will have had time to develop. Sometimes chemical fertilizers, such as nitrates or phosphates, are added to make special kinds of fertilizer, but that is a distinct business from the usual packing house plants and has been treated in other articles.

HAIR STORAGE AND DRYING HOUSES

present one of the most peculiar fire hazards of packing houses. Hog hair, when piled up, even three or four feet deep, before it is cleaned, heats up in a surprisingly short time. That is due to the oxidizing of the oils and other foreign matter in the hair. Sometimes fire starts and sometimes highly combustible gases are given off. When confined these gases will explode violently. Arrangement should be made for thoroughly washing the hair before it is put into bins, to ventilate the rooms, or to keep the hair well wet down with running water, until it can be cleaned.

BONE HOUSES

present the usual hazards of steam cooking, and there would appear to be a slight fire hazard in the dust from the saws and the cleaning and polishing machines.

SOAP MAKING

is found at some plants. That has been treated in other articles, however, and it will suffice to say here that these are not nearly as hazardous as other grease risks, unless rendering is done on the premises, as soap is hard to burn, and the greases are kept in tanks or barrels in separate buildings until the alkalies are added.

MEAT CANNING PLANTS

at packing plants present the hazards of steam cooking, soldering and some trouble with litter. The soldering is done usually on iron stands and under a vacuum, in patented soldering and hermetically sealing machines, so that there is usually little, if any, fire hazard. Labeling and lacquering the cans is more or less hazardous, according to the care of the management.

THE DRESSING ROOM HAZARD,

thanks to the government inspector, has been largely eliminated. They require the plants to provide separate rooms, with masonry walls, cement floors, metal lockers and well-kept toilet and lavatory facilities, and insist on the exclusive use of these sanitary sections for all the operative employees who handle edible products or who work in sections where edible goods are handled. That helps the insurance man, by preventing the hanging of greasy clothing back of doors, under stairways and in other handy places, as was formerly done, with the attendant constant danger of spontaneous ignition.

PRIVATE FIRE PROTECTION

is an indispensable and highly important feature of packing houses. It may range from a few barrels of water and a few pails in the small plants to the fully equipped private fire departments of the large plants. Essentially the following points should be observed:

BARRELS AND BUCKETS

or approved fire extinguishers should be provided in all risks, large or small, and regardless of the character of the construction or occupancy. These should be examined at least weekly, to see that they are in place and in good order, and at least twice a year a complete inventory and report should be made after a most thorough investigation, preferably in company with the insurance inspector and a man from the city fire department.

STANDPIPES AND FIRE HOSE

should be provided in all of the larger and more hazardous buildings and in the vestibules between the buildings, and a station should be provided on the roof. The latter should have a stop and waste valve on the top story of the building, controlled by a rod from the roof, so that the roof pipe will not freeze, but can be quickly used. These should be used for fire only and should be included in the report mentioned above.

FIRE LADDERS

should be provided, so located that any part of any building not have fireproof stair towers, with landings on each floor level from which the fireman can fight fires in the buildings without being cut off from escape, as is sometimes the case when they depend on ordinary inside stairs. A dry standpipe is considered a good addition to the fire ladders by some plants.

YARD HYDRANTS AND HOSE

should be provided, so lacated that any part of any building could be reached with not over 300 feet of hose. These should be interchangeable with the hose of the city; that is, the hydrant nipples and the hose couplings should have the same size and number of threads, and the national board standard is urgently recommended.

FIRE PUMPS, WATER SUPPLY

and other features should be of ample size for the worst possible fire, with allowance for breakdowns, and the pump house should be so located that it is not severely exposed by fire in other buildings. Only an inspection of each plant can determine just what is needed under this head.

FIRE DEARTMENT.

This should consist of at least one man and an assistant who give their whole time to inspection work and are ready to answer fire calls at any time of the day or night. Additional men should be provided as required by the size of the plant. These may be full-time men or they may be employed in the operation of the plant during the day and sleep at headquarters, or they may sleep at home nearby. In any case, they should be frequently drilled and should make frequent trips through the plant with the chief, so that they will be familiar with all apparatus, fire doors, peculiar hazards, etc.

The fire hall should be centrally located or at a point from which all parts of the plant can be quickly reached. It should be commodious, comfortable, sanitary, light, and equipped not only with fire-fighting apparatus, but with reading matter and a pool table and other amusement facilities, so that it will be

attractive to the men. But it should be kept locked and not made a lounging place except for the firemen.

THE FIRE APPARATUS AT THE FIRE HALL

should include an axe, hose spanner and other small equipment for each man, a large portable chemical engine, smoke helmet, pulmotor or other resuscitating apparatus, first aid kits, Pyrene or other approved one-quart extinguishers, and such other apparatus as the chief sees fit. Somewhere in the plant, preferably near the fire hall, should be a turret nozzle or deluge set for use at bad fires.

FIRE ALARM AND WATCHMAN SERVICE

should be provided. Central station service of the A. D. T. type should be provided if possible, with a gong and recorder in the fire hall. That is better than a duplicate private alarm system, as one is very apt to be overlooked and not used and the private or public department not called in case of fire. If supplemented by telephone stations in important buildings the system is pretty nearly perfect. Even then the human factor can not be overlooked and care must be taken in selecting the watchmen, and they must be frequently reminded and drilled in the proper reporting of fires. It must be impressed on them as forcibly as possible that they are not to fight even a small fire until they have turned in an alarm. If they fail in putting out the small fire it may be too late for the fire department to help.

With proper construction, keeping in mind the segregation of the fire hazards. the separation of the high values, and with proper attention to the care of the plant, frequent inspections, adequate watchman service and good business conditions, packing houses should be profitable risks for fire insurance companies; but if not well designed and cared for they are extremely unprofitable.

RUBBER MANUFACTURING.

Processes and Hazards Described—High Values in Such Risks.

By F. W. Eames, Factory Insurance Association, Northboro, Mass.

The manufacture of rubber goods has several distinct classifications, the processes carried on varying greatly in each and even in mills of the same class to some extent. The preparation of the raw stock, in order that it may be worked into special products, is, however, much the same.

Rubber is a substance prepared from the milky juices of certain trees, the nature of which and the preparation of the gum being not of special interest to the insurance engineer.

Rubber gum is a product principally of South America, Central America and Mexico, Africa, Ceylon and the Malay Peninsula, the larger portion being imported from South America.

Crude rubber may be divided into two classes, wild and plantation. The wild rubber usually comes to the mill in the form of "hams" and "buns," the hams being ordinarily loose and the buns in cases and bags. The plantation or cultivated rubber comes into our markets in the form of long, clean, crinkley crêpe ribbons or sheets put up in cases or bales. This crude rubber is usually stored in some dark place, such as the basement of some building, until such time as it starts through the various processes of manufacture.

THE CRUDE STATE.

Rubber in its crude state, especially that which does not come from the cultivated plantations, contains more or less impurities in the form of sand and vegetable matter, which work their way into the gum in the process of curing, and which it is very necessary to remove before it can be worked into the various necessary processes.

SOFTENING.

Before the crude rubber is cut up into suitable dimensions for the washing machines it is softened in hot water for a number of hours. This softening is done in wooden or steel vats containing water and usually heated by means of live steam. The process is generally carried on in some open or enclosed platform adjoining the wash room or in some open shed, this being done on account of the objectionable amount of steam and not on account of any fire hazard.

The crude rubber, after being softened, is cut up by means of large knives and is then taken to the wash room, usually located in the first story of the main building, where it goes through a washing process to remove the impurities.

WASHING.

The washing machine or "mill" is a very heavily built machine containing two heavy corrugated metal rolls, so arranged that the distance between them may be regulated. Above the mill is always a spray pipe, by means of which hot or cold water in greater or less quantities is always running over the rubber as it is run through between the rolls, so as to wash out the dirt and foreign matter. This process is repeated until the rubber is thoroughly washed clean and the rubber, then in large sheets, is ready for drying.

DRYING.

There are two methods of drying the rubber as it comes from the washers, both methods being in common use.

The old process, and one still commonly met with, is to hang the large sheets of rubber over smooth wooden poles in enclosed rooms especially constructed for this purpose, where it is allowed to hang for several days or weeks. The dry rooms are heated by means of steam coils, usually on the side around the bottom of the room, and there is a mechanically operated fan to facilitate ventilation and remove the moist air to the outside of the building.

Sometimes this same process is carried on, except that the sheets of rubber instead of being hung, are laid in perforated metal trays packed closely one above the other in racks.

The second method of drying consists of laying the sheets of rubber on perforated metal trays, which are put into a steel air-tight enclosure heated by means of steam coils, and a vacuum maintained by means of an air pump. This method, of later origin, is much more rapid, and complete drying is usually accomplished in about three hours.

COMPOUNDING.

In taking up the preparation of rubber it must not be forgotten that there are other ingredients which enter into the composition of rubber goods. These are added, not with the idea of adulteration, but to give the proper composition necessary for service conditions.

Some products are subjected to more severe wear than others, some require resiliency, some are intended to withstand heat or cold or require varying compression or tensile qualities.

Reclaimed rubber is a common ingredient entering into rubber compounds and comes to the plant in the form of thick calendered sheets or rolls. The reclaiming of old rubber is a distinct branch of the rubber industry, and the process being rarely

carried on at the plant, manufacturing rubber goods will not be here taken up. It is interesting to note, however, that the amount of reclaimed rubber consumed is said to be double that of the natural or crude rubber.

Next to the rubber itself, sulphur is the most important ingredient that enters into the rubber mixture, and it is this ingredient that makes vulcanizing possible. By its use the practically endless variety of substances adapted to make articles of every description has been rendered commercially possible. If rubber is mixed with either pure sulphur, the alkaline sulphides, the sulphides of alkaline earth, the metallic sulphides, or chloride of sulphur, and the mixture heated, the sulphur is more or less absorbed. According to the quantity of sulphur absorbed and the degree and amount of heat to which the mixture is exposed, the rubber becomes transformed into more or less hard and elastic substances.

The various ingredients which enter into the composition of the class of goods to be manufactured are weighed out and assembled in batches in the mixing room, which is commonly partitioned off from the main portion of the plant. Here may be found sulphur, litharge, calcined magnesia, slaked lime, whiting, barium sulphate, sulphide of zinc, tar, reclaimed rubber, etc., and various oils, resins and waxes and also numerous coloring materials such as lampblack, sulphide of lead, oxide of antimony, ferrous oxide, oxide of zinc, etc.

The mixing mills which are used in assembling the rubber and compounds are machines much like the washing mills, except that the faces of the rolls are smooth and are so arranged that they may be steam heated or water cooled. The rubber is first run through the mill until it has formed a smooth, pliable cover on the roll nearest the operator and then the other ingredients are gradually added, the compound being put through the mill repeatedly until it becomes a thoroughly mixed mass, when it is cut from the roll and is ready for the next process.

CALENDERING.

No matter what class of goods is to be manufactured from this compound, it must first be run into sheets, and this is done by means of a machine known as a calender. The purpose of the calender is to free the compound of any bubbles and to roll it into a smooth sheet of uniform thickness preparatory to its application to any of the numerous uses to which it subsequently may be put.

The calender is a heavily built machine having two, three or four steel rolls, arranged one above the other, the three-roll being the most common type. These rolls are fitted with arrangements for heating or cooling and they also have adjustment devices both as to speed and distance between rolls. At the end

of the calender there is usually an apparatus for reeling up and unreeling the material in process.

The material to be run through the calender has often been prepared for some time and for this reason it is put through a "cracker" to knead the compound. The cracker is a two-roll mill, one roll being smooth and the other corrugated. It is then run through a warming up process on a mixing machine, cut into small pieces and fed to the calender between the two upper rolls.

The compound passes between the upper and center rolls. Half way around the center roll it is received on a cloth and runs between the center and lower rolls and is reeled up on the reeling device previously referred to.

Four rolls are operated in a similar manner, three rolls being used for working and the fourth for receiving the rubber on the cloth sheet.

Some classes of mills, such as rubber boot and shoe factories, and some mechanical rubber plants, require various designs to be marked out on the calendered sheets. This is done by means of another roll inserted in the calender machine, the roll being engraved with the required designs. This roll presses against the delivery roll in such a manner that the calendered sheet receives the design of the sole, upper, etc., or for the marking of any desired article.

There are also "friction calenders," which are generally three-roll calenders in which the rolls revolve at different speeds.

Friction calenders are employed to "friction" or impregnate with rubber compound fabrics, such as cotton duck, which are used in the manufacture of automobile tires, rubber hose, transmission belts, etc. In this process the upper and lower rolls are run at the same speed and the center roll runs faster. The materials are run through the machine in much the same maner as in ordinary calendering. The lower roll is set up tight against the center roll and the cloth running through, instead of receiving the calendered sheet, has the rubber compound forced into the fabric by the action of the two lower rolls revolving at different speeds.

Fabrics are coated in the same manner, except that the two lower rolls are run at the same speed and the compound is not forced into the fabric as in the frictioning process.

Calenders are also used for "doubling" or making a thicker sheet of the same or different stock. In doing this the previously calendered sheet is run through between the two lower rolls and the new material as before; the two being brought together result in a sheet made up of layers which cannot be separated.

Two-roll calenders are used principally for running a sheet of compound where it is of no importance to obtain a uniform thickness.

RUBBER CEMENT.

Rubber cement is used in practically all rubber mills and is usually manufactured at the plant. The cement is raw rubber with a small amount of compound dissolved in high-grade naphtha. The rubber in this mixture has been washed, dried, compounded and rolled into sheets. It is then cut up and mixed with the solvent by means of churns operated mechanically.

The rubber "dough," which is really a thick rubber cement, is made in the same manner and is used in the coating of fabrics by means of "spreader machines."

In the preparation of the stock entering into the manufacture of rubber boots and shoes, rubber hose, automobile tires, moulded rubber goods and many mechanical rubber goods, the processes are much the same up to this point. The plants engaged in the manufacture of various classes of goods or different grades of goods in the same class vary but slightly. But here begins the introduction of a diversified number of processes to work the prepared stock into the desired form, depending upon the product of the plant.

RUBBER BOOTS AND SHOES.

In the rubber boot and shoe factory the sheets of rubber stock from which the uppers and soles are cut are made up on the calenders and at this stage of the work are plastic and very sticky. For this reason the sheets are placed on wooden frames covered with cotton cloth arranged in such a manner that the frames can be piled without the stock coming in contact with other stock, and in this form they go to the cutting room.

CUTTING.

In the ordinary rubber shoe there are from ten to fifteen pieces and the common boot contains over twenty-five pieces.

The linings and such parts as can be piled up layer on layer are cut by dies, usually on large beam cutting machines. The uppers are cut by hand from the engraved sheets while metal patterns are used on the plain stock. The soles are cut by specially designed machines.

On account of the fact that the sole and upper pieces are very sticky, it is necessary to cut them one by one and keep them separate by placing them between the leaves of large cloth books.

HEELS.

The heel stock is made up to the proper thickness with numerous layers of calendered rubber. This stock is then cut into the proper shape and size by means of dies so as to fit the heel moulds and they are then partially vulcanized in steam-heated presses.

The heel press is a simple press with an upper and lower plate in which are the forms for several heels. These presses are sometimes operated by hand, but more often by hydraulic pressure.

MAKING.

The various pieces are next delivered to the making department, where they are fitted together on "lasts" or "trees" in such a manner that all of the joints and seams are covered and the lines of the boot or shoe kept exact. This work is entirely hand work, the seams being cemented together by means of rubber cement and rolled down smooth and firm.

Most of the lasts are made of hard wood, but in some cases metal lasts are used.

VARNISHING.

After leaving the making room, the boots and shoes on the lasts are taken to the varnishing room, where they are given a coat of varnish if they are to receive a glossy finish; if not, this process is omitted.

The varnish is composed mainly of linseed oil. It also contains rosin or some cheap varnish gum and a small amount of sulphur. The mixture is boiled in large iron kettles heated by means of wood, coke or hard coal fires.

After the varnish has been boiled the required length of time it is thinned down with naphtha and stored in metal tanks in a room adjoining the mixing room. The varnish is applied by means of a brush or the shoes are dipped in metal tanks containing the varnish. When the dipping process is used they are dipped by hand, one by one, although many factories are now adopting a system whereby several shoes may be put onto a rack and the entire lot dipped at one time.

From the varnishing department the boots and shoes are taken on skeleton frame metal cars to the vulcanizing department.

VULCANIZING.

There are two forms of vulcanizer in use in boot and shoe factories, the most common being an air-tight enclosed room, usually tin-lined having double walls with air space between to prevent radiation of heat. These vulcanizers or "heaters" as they are commonly called are provided with a system of steam coils to supply the necessary amount of heat. They are fitted with recording temperature gauges, and in some instances with automatic temperature control apparatus on the steam heating system.

The cars containing the boots and shoes are run into these heaters, each being large enough to contain several cars.

The temperature at which the heaters are operated varies from 125 to 250 degrees. The time consumed in vulcanizing varies according to the amount of sulphur used in the compound, the composition of the compound, the manner in which the heat is applied and the shape and size of the article being vulcanized, although six to seven hours is a common period.

Another form of vulcanizer now coming into general use is

a large air-tight metal boiler-like receiver provided with a system of steam-heating coils around its entire inside surface. Into this the cars of boots or shoes are run, the receiver closed and subjected to a vacuum of about 28 degrees, after which carbonic acid gas ($C O_2$) under a pressure of about 30 lbs. is let in.

In this process it is necessary to have special hollow metal lasts and special cars constructed of pipe, the lasts containing the boots and shoes being screwed into the pipe frame of the car and the whole connected to an outside vacuum pumping system.

The temperature at which these vulcanizers are operated is about 275 degrees and the time consumed in vulcanizing about two hours.

The heating or vulcanizing process fixes the elasticity of the rubber, increases its strength and unites the parts in such a manner as to make the boots or shoes one piece and in this process the adhesiveness of the rubber compound is lost.

PACKING AND SHIPPING.

The boots and shoes next go to the packing department, where they are taken from the lasts, trimmed, inspected, marked, tied together in pairs, sorted and packed. They are then ready for shipment.

RUBBER AUTOMOBILE TIRES.

In taking up the processes connected with the manufacture of automobile tires no consideration has been given to the making of special patented types.

PNEUMATIC TIRES.

Cutting.—The material entering into the manufacture of ordinary pneumatic tires is "frictioned" canvas and "calendered" rubber compound.

The stock is made up in sheets and goes to the cutting department, where it is cut into strips of the required length and width, the frictioned canvas being cut on a "bias" of 45 degrees.

Making and Vulcanizing.—There are two methods of making up the "casing" or "shoe," one being known as the "single cure" and the other as the "double cure" process. The tire casing is built up of frictioned canvas, layer by layer, on iron forms, there being four to nine plies or layers, according to the size and style of the tire. These layers are drawn onto the form by hand or by a special machine and rolled firmly together on the form, the rim "beads," composed of a hard rubber compound and containing wires, which have previously been made up with a tube-making machine, being made in at the same time.

When the necessary number of plies have been built up a covering of calendered rubber stock is made over the entire casing. There is no rubber cement used in this making up process.

If the casing is to be single cured, the "tread," which has been previously built up of several thicknesses of calendered rubber stock so as to be thick in the center and thin at the edges, is put in place and the entire casing on the form put into a two-piece iron mould and vulcanized.

If the casing is to be double cured, it is partially vulcanized in the same manner without the tread.

The vulcanizing is done in large upright steel boiler-like receivers by means of live steam under about 40 lbs. pressure. During vulcanization the moulds containing the tires are pressed together by heavy hydraulic pressure.

After proper vulcanizing the casings are removed from the moulds.

If the casing has yet to receive its tread, as in the case of a double cured tire, it is taken from the mould after partial vulcanization. The surface is roughened, and the tread, which has also been partially vulcanized, and which is in a continuous belt-like piece, is made onto the casing with rubber cement. The entire casing, still on the form, is then wound with wet fabric tape by means of a special machine, which winds it on under tension, and the casing again vulcanized without putting it in a mould.

Inner Tube Making and Vulcanizing.—The inner tubes are made up of calendered rubber stock, which is cut up into strips of the required length and width. These strips are wound once or twice around smooth steel tubes, depending upon the weight of the tube desired, the seam being lengthwise of the tube.

As the rubber stock is sticky at this stage of the process, no cement is necessary. A small oval piece of rubber to form reenforcing where the valve stem is to be inserted is put in place and the entire tube on the form tightly wound with wet fabric tape, after which the tube is partially vulcanized in steel boiler-like receivers by means of live steam under pressure. The tubes after being taken from the vulcanizer are removed from the forms, being then in the form of a straight piece of hose. The ends of the tube are then roughened and coated with rubber cement, after which they are bent over forms, depending upon the size of the tube and the ends telescoped together. They are then put through the final vulcanizing process in receivers, the same as previously mentioned.

After the final vulcanizing the valve stem is inserted and screwed into place, the tube inspected, tested and properly marked and packed in pasteboard boxes for shipment.

Some inner tubes are entirely made up on the steel forms and vulcanized by a single operation, the ends being later cemented together and brushed over with a solution of sulphur chloride mixed with carbon disulphide or carbon tetrachloride in order to vulcanize the joint.

Some factories have special machinery to aid in winding and forming the frictioned canvas and calendered stock onto the forms, the advantage claimed for this form of making being that the machine draws them onto the forms with a more uniform tension, but the makers of hand-made tires claim that this difference is not marked when the hand work is done by skilled operatives, and that the hand built up tire gets more careful personal attention by the workmen.

SOLID RUBBER TIRES.

Preparation of Bands.—Solid rubber automobile tires are made up on steel bands. The bands, as purchased from the machine shop, are roughened and have dove-tail grooves around the outside surface so as to make the rubber compound adhere tightly to it. At the plant the bands are allowed to "weather season" in the yard in order to remove grease, but before the tread is put on they are thoroughly cleaned by sand blast or with a solution of acid. They are then naphtha washed with wire brushes.

Making.—After the band is cleaned it is given about two coats of hard-rubber cement in order to fill in the grooves. This cement is applied with a brush while the band revolves slowly in a stand.

There are two methods of applying the tread. By one method it is built up on the band layer by layer, with calendered rubber compound, the whole being mechanically rolled into one mass. By the other method the tread is made up on a tube-making machine and then rolled onto the band.

In the latter method the compound has passed through the mixing operation. It is first warmed on a mixing machine and then fed into a tube-making machine, where, by means of a worm, it is forced through a die the size and form of the desired tread.

From the die of the tube machine it is run onto long tables and is cut up the proper length. It is then rolled onto the band by a semi-hand operation, the only machinery used being a slowly moving power-driven roll-device, which rolls the tread tightly into place. The tread before being rolled onto the band is so cut that the ends form a bevel lap, and rubber cement is used in making the joint.

Hard rubber cement is made up in the same manner as ordinary cement, except that a greater percentage of sulphur is used in the mixture, causing it to become hard when vulcanized.

After the tire has been made up it is put in a two-piece iron mould and is then ready for vulcanizing.

Vulcanizing.—The vulcanizing of solid rubber tires is done in a large boiler-like receiver or vulcanizer, usually set on end, and in this the moulds containing the tires are tightly pressed together by means of a hydraulic pressure of 1,600 to 3,500 lbs. per square inch.

The vulcanizing is done by live steam under about 40 lbs. pressure and at a temperature of about 290 degrees. The time consumed in the operation is from 2½ to 5 hours.

After vulcanizing the tire is taken from the mould and is ready for shipment.

It will be seen by this that while the preparatory machinery, such as rubber washers and dryers, mixers and calenders, are practically the same in tire factories as in other rubber plants, there is little machinery in the actual making up of the tire.

RUBBER COATED FABRICS AND CLOTHING.

There are two methods of coating fabrics with rubber com pound. The heavier coated fabrics are generally manufactured on calenders previously described and the lighter coated fabrics by means of spreader machines.

Spreading.—A spreader machine is a skeleton table-like structure made up with steam coils or steam-heated plates. At the feed end of the spreader is located a roll, above which, and parallel to it, is set a knife-like piece of metal, fitted with proper adjustment device so that it may be set a greater or less distance from the roll. There is also provision for a roll of fabric at the feed end and a reeling up device at the other end of the machine.

The rubber compound known as "dough" is manufactured in a similar manner as rubber cement and is a composition of crude rubber and compounds, which has passed through the calendering process, mixed with naphtha.

In the spreading operation the fabric is led over the roll beneath the knife and crosses the length of the steam-heated table to the reeling-up device. The dough is placed on the roll in front of the knife and as the cloth passes through it is coated with a thin uniform layer of the rubber compound, being dried over the steam-heated coils or plates, and is reeled up at the end of the machine.

Some fabrics receive more than one coat of compound by repeating the operation and some coated fabrics are "stripped" after coating, the operation being similar to the coating process, except that a thin colored rubber mixture is used in place of the dough and a special knife having small nitches is used.

Vulcanizing.—The vulcanizing of rubber fabrics is accomplished in two ways—in a dry heater constructed in a manner similar to that used for vulcanizing rubber boots and shoes, already described, and in which the coated fabric is hung in festoons—and by a process known as "acid" or "vapor" curing.

Fabrics to be acid cured contain no sulphur in the coating compound. The vulcanizing or curing is done in a heater similar to the dry heater, except that it has fewer steam coils, the maximum heat desired being only about 150 degrees.

The coated fabric is hung in festoons in the heater, in which are placed small vessels containing sulphur chloride mixed with carbon disulphide or carbon tetrachloride and the applied heat causing the mixture to vaporize, the sulphur chloride vapor acts upon the rubber compound and vulcanization takes place.

Many times fabrics are made up of two pieces of cloth with rubber compound between. This fabric is much used in some kinds of raincoats and is made by forcing one piece of cloth onto the coated surface of another by means of heavy rolls, between which the fabrics are run before the rubber coating has thoroughly dried. Vulcanizing is accomplished in the same manner as in other coated fabrics.

Clothing Making and Vulcanizing.—In the manufacture of rubber clothing the coated fabrics are sometimes made up before being vulcanized and sometimes, especially when acid cured fabrics are used, after curing.

The fabric is cut on tables by means of shears or electrically operated cutters from patterns as required by the garment to be made up, and the pieces cemented or sewed together according as the case may be. Garments made up before vulcanizing are hung on special forms in dry heaters similar to those already described.

After being finished, the garments are properly inspected, sorted and marked and packed in pasteboard boxes or hung in racks in suitable storage rooms.

SPECIAL HAZARDS, BOOTS AND SHOES.

STORAGE OF CRUDE RUBBER.

The storage of crude rubber presents no undesirable feature from an insurance engineer's point of view as it is not readily inflammable or liable to spontaneous ignition. From an underwriter's point of view this storage is important on account of its value and care should be taken that large values are not stored in one fire area.

SOFTENING.

There is no hazard in connection with the softening or soaking of crude rubber, as this is entirely a wet process.

WASHING.

Rubber washing, in spite of the common presence of foreign substances, is a non-hazardous process. The fact that water is necessary and freely used throughout the operation makes the origin of fire at this stage impossible.

DRYING.

In the drying department the engineer is more especially interested in the arrangement of the heating and ventilating systems as applied to the open room or so-called "loft drying," and the

underwriter's interest lies in the matter of values which are liable to be large in manufacturing plants of considerable size.

All steam heating coils should be hung on metal and bushed when passing through wood partitions. The coils being commonly on the side of the room, care should be taken that they are protected by screens to prevent stock coming in contact with them.

When a mechanically driven fan is used to facilitate ventilation, it should be so arranged that all bearings are easily accessible and the device kept properly oiled and cared for. When this fan is driven by means of a belt passing through either floors or fire walls the entire belt should be properly enclosed or hooded to prevent its being a medium to convey fire or air currents between floors or sections.

All lights in the dry room should be electric incandescent so arranged that they cannot come in contact with the rubber stock.

In the vacuum system of drying, the apparatus being of iron and heavily built, and the rubber contained in metal trays so that it cannot get in contact with the heating coils, there is no fire hazard connected with the process.

COMPOUNDING.

The compound mixing room contains little of special interest to the inspector and it is quite fortunate that this is so, especially if he be other than a chemist. Here is usually found but a small supply of the various ingredients which go to make up the rubber compound, the main supply being as a rule stored in original packages in some proper storehouse.

Lampblack is a decidedly dangerous substance composed almost entirely of carbon and will ignite spontaneously if the proper amount of moisture is present. Care should be taken that this storage is kept in some dry place preferably removed from large values.

While sulphur in greater or less quantities is always found in rubber mills, in itself it presents no special fire hazard except that it is an added fuel and gives off objectionable and suffocating fumes when burning.

Reclaimed rubber involves no more hazard than the ordinary crude rubber already referred to, and the various oils, waxes, resins, etc., present no undesirable feature when ordinary care is exercised in their storage.

While on the subject of chemicals, mention might be made of carbon disulphide. Although this chemical does not enter into the composition of rubber compounds it is sometimes used in the vulcanizing or so-called curing process of certain articles.

Carbon disulphide is a highly inflammable and dangerous liquid even at low temperatures and is very similar to benzine and naphtha in its explosive qualities. It should always be stored in

some detached shed of small value and its use discouraged when possible.

Naphtha or benzine is another common liquid found in nearly all rubber mills; in fact, it is this solvent and not the rubber or the compounds themselves that constitutes one of the greatest and most important hazards in connection with the usual manufacture of rubber products. It is commonly met with in large quantities when in storage and should always be kept in metal tanks installed in strict accordance with the standards set forth in the underwriter's requirements. The use and storage of naphtha or bezine should be carefully investigated and only small amounts permitted at any time in manufacturing buildings.

MIXING.

The mixing mills offer no material hazard as the temperature incidental to the process cannot be carried high and the materials being compounded unlikely of ignition.

CALENDERING.

Calendering in any of its forms, including frictioning, involves no special fire hazard. There is undoubtedly present in the process a tendency toward the generation of static electricity, but the necessary water and steam connections to the machine are such that there is always a proper ground. This, taken together with the fact that the degree of heat used is low and the stock in process contains no highly inflammable ingredients or vapors, makes the origin of fire here remote.

RUBBER CEMENT.

In the manufacture, as well as in the use, of rubber cement, there is an especially serious fire hazard. This is due to the naphtha solvent necessary to get the rubber compound into solution, and many fires originating in cement mixing departments are largely due to the fact that rubber is easily electrified by friction and pressure and the resulting static spark ignites the naphtha fumes in the churning operation. For this reason cement churns should have all parts grounded and it is well to place roll of rubber compound upon a grounded metal plate before feeding it into the churn.

The manufacture of rubber cement should always be carried on in some well detached, preferably fire-proof building and the room well ventilated. The power for the churns should always be from the outside of the room by means of a shaft or some form of drive permitting a perfect cut off. The lighting, if artificial, should be by means of double enclosed incandescent lamps with weather-proof keyless sockets and all controlling switches located outside of the room where naphtha fumes are present, preferably outside of the building.

All naphtha storage tanks should be buried away from buildings and the naphtha pumped by means of one of the several

pumping devices approved for this work. This pump may, however, be located in the cement mixing room or building. Naphtha should never be forced into the room or building by means of a pressure or gravity system.

CUTTING AND MAKING.

In the cutting processes there is no special hazard.

The entire hazard of making lies in the use of the rubber cement.

The cement is used from small open pans at the making benches, and these pans are filled from large cans located at some central point in the making room. Owing to the cost of the material it is usually well cared for.

There should never be more than one day's supply brought into the plant. The distributing cans should be provided with tight fitting metal covers and all cement should be collected and returned to the cement house at the close of work. The use of naphtha for thinning the cement at the benches should be avoided, and such naphtha as is used for thinning at the supply or distributing cans should be kept in approved metal safety cans.

A supply of pails filled with sand or whiting should be provided convenient to all benches where rubber cement is used and it is also well to distribute about the room a good supply of wool blankets.

All lights in the making room should be electric of the incandescent type, preferably in keyless sockets.

VARNISH MAKING.

Most rubber boot and shoe factories manufacture their own varnish. This should be done in a detached, preferably fireproof building or in a fire-proof room cut off from the adjoining property.

The fire hazard being much the same as the cement mixing, an ideal arrangement is a four-section, one story, fire-proof building so divided that there will be one section for rubber cement mixing, one section for cement storage, one section for varnish making and one section for varnish storage. The sections should be cut off from each other and the division between the cement and varnish departments a blank brick wall.

The varnish is often brought into the varnishing room as needed and here the supply should be kept in metal cans provided with tight fitting metal covers. All of the varnish remaining at the close of the day's run should be collected and returned to the varnish storage room.

A much better and safer arrangement, and one now in quite common use, is to pump the varnish from the storage tanks to the tanks and dipping trays in the varnishing room. These tanks and trays are provided with return pipes and the varnish is allowed to drain back to the storage tank at the close of work.

Under this arrangement the filling and draining pipes contain varnish but a very few minutes in each day, and for this reason may be run through manufacturing buildings to a reasonable extent.

The lighting system in the varnish-mixing room should be an electric incandescent system installed under a similar arrangement as that mentioned in the case of the cement-mixing room.

The varnishing of rubber boots and shoes is not a hazardous operation in itself, but as the varnish is composed of inflammable material giving off combustible vapors, all of the precautions necessary under such conditions should be exercised.

VULCANIZING.

The hazard of vulcanizing cannot be considered to amount to more than the ordinary steam pipe hazard, steam heat being now almost invariably employed in all plants for vulcanizing. When the ordinary heater is employed, these should be tin-lined and all steam coils supported on metal and arranged so that the stock cannot come in contact with them. The heaters should be provided with a live steam jet having a controlling valve easily accessible in order that it may be flooded with steam in case of fire. It is also quite necessary that the steam coils be arranged so that dirt and litter may be cleaned from beneath and around them. This is especially important in regard to the coils installed on the floor of the heater.

In the carbonic acid gas system of vulcanizing, there is no fire hazard, as the heavily constructed iron receiver is filled at all times during the process with a fire-extinguishing gas.

There is no hazard connected with heel vulcanizing.

PACKING AND SHIPPING.

In the inspecting, marking, packing and shipping departments there is no special hazard. These rooms usually contain many pasteboard boxes and wrapping paper for packing purposes which may add fuel to a fire or increase a water damage loss, but there can be little or no danger of fire if ordinary precautions are taken to keep waste material cleaned up and removed.

STORAGE OF FINISHED GOODS.

There is no special risk connected with the storage of finished goods. These are usually kept in a storehouse constructed for the purpose. The storehouse should be so divided with standard fire walls, however, that the value in any one fire area may be kept as low as possible.

AUTOMOBILE TIRES.

In the manufacture of rubber tires the processes consist of crude rubber soaking, washing and drying; compounding and mixing, calendering, cutting, making and vulcanizing, and the

making of rubber cement. Up to, and including, the calendering these processes are practically the same as in the case of rubber boot and shoe factories and already referred to.

CUTTING AND MAKING.

In the cutting room the work is done by hand, on benches, and presents no special hazard. No hazard is introduced in the making or building up of the pneumatic tire casing on the form or in the making of the inner tubes. In the making up of solid tires there is no special hazard, except in the application of the hard-rubber cement on the band and the cementing of the bevel lap of the tread. A slight hazard is introduced in cementing the pneumatic tire tread onto the semi-vulcanizing casing, when this process is employed, and also in cementing together the ends of the inner tubes. These hazards are due solely to the presence of naphtha in the rubber cement and not to any mechanical operation and being of such a minor nature, no special precaution or protection is necessary except to provide near at hand a supply of pails filled with sand or whiting and to see that all cement is removed at night to some especially constructed or detached room or building for this purpose.

When rubber cement is manufactured at the plant the same precautions are necessary as previously referred to under Boot and Shoe Factories.

VULCANIZING.

Vulcanizing is done in heavy iron receivers by means of live steam applied under a pressure of 40 pounds or so. For this reason there is no fire risk connected with this form of vulcanizing. It is, however, well to note that there are instances on record where this type of vulcanizer has exploded, and in order to properly protect life and property, as well as to safeguard and maintain fire protection, there should always be provided a pressure relief valve so set as to prevent dangerous excessive steam pressure building up in the receiver. A pressure gauge should also be provided and so located that the workmen may note at a glance the pressure on the vulcanizer.

When the cemented ends of the inner tubes are vulcanized with a solution of sulphur chloride and carbon disulphide a special hazard is introduced on account of the carbon disulphide. Rooms where carbon disulphide is used should be well ventialted, the quantity used in the room kept as low as possible, and the general precautions taken that apply to the use of naphtha.

PACKING AND SHIPPING.

In the inspection, sorting, marking and shipping departments the fire hazard is absent. Inner tubes are usually packed in small pasteboard boxes and the casings and solid tires wound with heavy paper or new burlap, but if cleanliness is practised in this

department and all storage kept free of the heating circulation pipes there will be no danger of fire.

STORAGE.

Automobile tires are, in a sense, a "seasonable product" or, in other words, they are used more extensively at certain seasons of the year. For this reason a plant which ordinarily operates at a constant rate of production will accumulate large values in finished goods during the winter season. There is no fire hazard in connection with this storage and the inspector may not interest himself in matters other than its arrangement with reference to the proper distribution of the water from the sprinkler protection. An ideal arrangement for storage of tires consists of skeleton pipe-constructed racks in which the tires may be set up side by side in tiers.

From an undewriter's point of view the storage should be in some well cut off or detached storehouse so divided by standard fire walls as to prevent the accumulation of large values in one fire area.

RUBBER COATED FABRICS AND CLOTHING.

The hazards connected with the washing and drying of crude rubber and the mixing and calendering of rubber compounds have already been taken up and described.

Dough making involves the same hazards as that introduced in the manufacture of rubber cement, also previously mentioned, and all of the care necessary on account of that process should apply to this also.

SPREADING.

Spreaders are the source of many fires. This is due to the presence of naphtha in the dough which is ignited by the spark resulting from the static electric charge generated in spreading the dough upon the fabric, or the movement of the coated fabric over the rolls. Coated wool fabrics are said to be the most dangerous when taking this process and cotton fabrics the least.

A device known as the "Chapman Neutralizer" has come into general use which prevents the accumulation of the static electric charge. This device consists of a number of specially constructed wooden rods which are set across the spreader at several points, over rolls, etc., close to the coated fabric. These rods contain numerous metal points set in porcelain cups, and all are electrically connected to an alternating current system, stepped up by means of special transformers to a low amperage system (3 amp.) of about 13,000 volts. This system in instances where installed has reduced the number of fires to a minimum and could well be recommended on all spreaders.

High humidity is another effective means of preventing static electric fires in the spreader process. This may be done by in-

stalling perforated steam pipes in such a manner that a small amount of live steam is playing upon the fabric as it is being coated with the rubber compound and passing through the spreader; or the relative humidity of the room may be maintained sufficiently high to prevent the accumulation of an electric charge, forty to fifty per cent. being sufficient under ordinary conditions.

It is also necessary to properly ground all portions of the spreader machine and also to provide a grounded metal plate for the operator feeding the machine to stand upon.

Spreader rooms should always be equipped with live steam hose connections arranged with hose and nozzle always connected for immediate use.

CUTTING AND MAKING.

The cutting and making of rubber coated clothing involves no special hazard other than the use of rubber cement utilized in assembling the several parts. The sewing machines are set on long tables and here the principal hazard is confined to the care of the line shafting under the tables which operates the machines.

VULCANIZING.

When fabrics are heater-cured and when rubber coated clothing is cured after making, the heater is practically the same as found in the rubber boot and shoe factories and the same may be said of the fire hazard involved.

When coated fabrics are cured by the use of sulphur chloride and carbon disulphide, a serious fire hazard is introduced owing to the extreme volitility of the inflammable vapor given off by the carbon disulphide. The use of carbon disulphide should always be avoided if possible, and carbon tetrachloride used in its stead as no hazard results from the use of this chemical.

IN GENERAL.

Large rubber manufacturing plants frequently operate their own printing establishments where are printed labels, cartons, etc., and even circulars and advertising matter connected with the business.

Here the danger lies principally in the use of naphtha for cleaning type, etc., and the care of waste-paper and sweepings.

In such departments the naphtha should always be kept and used from approved safety cans, and only a day's allowance permitted in the plant at one time.

The plant may also make up its own pasteboard boxes and in this the important hazard is that of waste-paper and cuttings.

These processes, taken together with the repair departments, both mechanical and electrical, and the making of wooden packing cases from either shooks or lumber and where the wood

working hazards enter to a small extent, complete the operations and hazards of the usual rubber manufacturing plant.

Cleanliness is a very necessary essential to every well organized factory, and the rubber factory is no exception. It should be insisted upon in each and every department of the plant.

A full equipment of fire pails and extinguishers as well as sprinklers throughout every portion of the property, together with yard hydrant and hose protection is also necessary, and while it is not the intention of this article to take up in detail the installation of such protection, it is well to emphasize the fact that all should be provided and installed according to the practice laid down by modern standards.

It has not been generally considered as necessary to sprinkler the so-called dry heaters or vulcanizing rooms such as are commonly used for rubber boots and shoes and rubber coated fabrics and clothing. It is quite apparent that any sprinkler protection installed in such heaters would at once become loaded with the deposit resulting from the sulphur fumes. This taken together with the fact that the sprinklers must of necessity be hard degree, would render them quite useless. The liability of accidental opening and the resulting damage would seem to be greater than the actual fire risk and for this reason the manufacturers have not taken kindly to suggestions along this line and the underwriters have been loathe to press for such protection.

A few sprinklers installed on a live steam connection is a common and effective means of protecting small rooms containing such hazards as cement and varnish making. In the installation of such a system it is simply necessary to provide a "U" in the pipe between the supply and the first sprinkler so that water will accumulate and prevent live steam from standing up to the heads.

Care should be taken to see that the connection is taken from a constant and reliable steam supply. It is not advisable that such a system be installed as a substitute for standard sprinkler protection, although it might in some instances be installed in conjunction with such a system.

CONCLUSION.

The office has requested that this paper be confined to the manufacture of Rubber Boots and Shoes and Rubber Automobile Tires, but on account of the fact that many plants with which you will come in contact make use of the "spreader machine" for one purpose or another, the subject of Rubber Coated Fabrics and Clothing has been included in order to explain this operation and its hazards.

It is the hope of the writer that at some future time this

paper may be made more complete by the addition of the processes and hazards connected with the manufacture of Mechanical Rubber Goods, Druggists' and Stationers' Supplies, Hard Rubber Goods and such miscellaneous goods as may be of interest. It may not, however, be entirely out of order to mention briefly, and in a general way, some of the other processes that may be met with in factories other than the classes mentioned in this article.

In the manufacture of cotton-rubber-lined fire hose the rubber lining is made up of calendered rubber stock formed onto a steel tube and semi-vulcanized. This lining is then drawn through a woven cotton jacket and is vulcanized in place with live steam under pressure.

Rubber garden hose is made up of frictioned fabric and calendered rubber stock wound on steel tubes and vulcanized.

Rubber carriage tires and light vehicle tires are made by means of a tube machine and vulcanized flat under pressure between special grooved steam heated plates in lengths of twenty feet or so, several lengths being vulcanized at one time.

Rubber tubes are made up around mandrels and allowed throughout the vulcanizing process to remain embedded in pulverized chalk, which affords a support for many other articles that tend to lose their shape during this process. Seamless tubing is made with a tube machine much in the same manner as lead pipe, by forcing the mixed compound through a die and curing in chalk as mentioned above.

Hollow articles, such as playing balls, injection bottles, etc., are vulcanized in iron or brass moulds which are tinned inside and very slightly greased. Before being put into the moulds these articles are roughly put together, and the expansion of the included air forces the rubber into contact with the internal surface of the mould, or a little carbonate of ammonia enclosed in the article accomplishes the same purpose.

Belting intended for driving machinery is built up of canvas which has been thoroughly frictioned with rubber compound, and is vulcanized under pressure between steam heated plates.

Packing for stuffing boxes of steam engines is similarly prepared from strips of rubber and frictioned canvas, as also are the so-called insertion sheets in which layers of rubber alternate with canvas and even wire gauze.

In the manufacture of rubber valves, washers, etc., the article is generally roughly fashioned from mixed rubber compound and vulcanized in moulds. Rolls are made to adhere to their metal spindles by the intervention of a layer of hard rubber compound or "ebonite" and after vulcanization they are turned.

When the vulcanization of rubber is carried too far, from the presence of a very large portion of sulphur and an unduly long action of heat the rubber becomes hard, horn-like and often

black. Rubber hardened by over vulcanization is largely manufactured under the name of ebonite or vulcanite. It is usually made by incorporating about 40 per cent. of sulphur in the compound, shaping the required articles from the mass and heating for long periods.

The fire hazards connected with these various processes are much the same as those already explained in detail.

In closing it may be of interest to note a list of over 200 fires reported to the National Fire Protection Association. This list lacks much information necessary in order to make a thorough and comprehensive analysis of the hazards and it is evident that in many cases standard conditions did not exist, but it is interesting in that it shows the numerous causes which go to make up the fire loss in rubber manufacturing plants.

Of these 207 fires reported

20 have occurred in storage rooms.
4 in receiving and shipping departments.
15 in drying departments.
4 in compounding rooms.
4 in calendering rooms.
4 in cutting rooms.
18 in cement and daub mixing departments.
3 in making rooms.
36 in spreading rooms.
4 in varnishing departments.
3 in dipping departments.
1 in sewing rooms.
5 in acid curing departments.
2 in finishing and inspection departments.
3 in spot-proofing departments.
2 in oil rooms.
4 in shoddy grinding rooms.
2 in cloth rooms.
2 in machine shops.
4 in carpenter shops.
7 in boiler rooms.
2 in engine rooms.
4 in offices.
28 in miscellaneous places.
26 regarding which there is no data.

Tabulated in another form these same 207 fires appear as follows:

Common hazards—

power	8
lighting	11
heating	11
smoking	6

matches	4	
lightning	1	
miscellaneous	9	
	—	50
Special hazards		125
Exposures		2
Incendiary		1
Unknown causes		29

It is also interesting to note that 5 fires originated on account of the use of carbon disulphide, 1 fire started in lampblack storage and 46 fires were caused by static electricity.

CHURCHES.

Hazards and Types of Construction.

By Charles C. Dominge, Engineer-Underwriter, New York City.

"Holy smoke" is an expression used by the street gamin and this "slang classic" was evidently coined at one of the large church fires. Contrary to expectation, a church makes a very hot fire and owing to the construction at once becomes a mass of smoke and flame. Not long ago I witnessed the burning of a large frame church in Richmond Hill, Long Island, and in the distance the heavy dark smoke was not unlike the smoke from the burning of a lard rendering or other grease risk. The firemen arrived at the fire in a short time only to find the entire shingled roof a roaring furnace.

TYPES OF CONSTRUCTION.

The frame church is in the "eyes" of the underwriter a rather poor fire risk in that they are mostly very old and lightly constructed with considerable area and many concealed spaces, numerous ducts and perhaps several tall spires or towers and a shingle roof. The stucco covered church is perhaps a shade better than the frame in that the outer walls are covered with wired lath and cement plaster.

ORDINARY CONSTRUCTION.

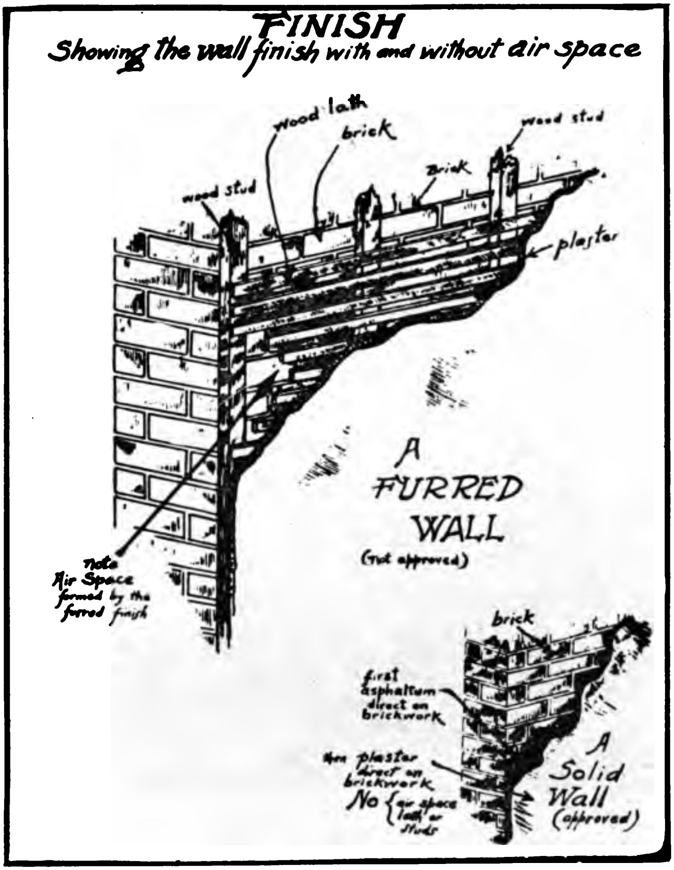
The ordinary constructed church is the type most prevalent in our local field. In this class the exterior walls are either common brick or stone, sometimes highly ornamental and in other cases perfectly plain. The first floor is ordinary wood beams, say 3 inches by 12 inches—16 inches on centers, covered by light floor boards and supported by unprotected cast iron columns, while the roof is supported by an unprotected steel truss with wood purlins, to which the wood roof boards are nailed. The side walls are usually furred with wood lath and plaster forming a concealed space between the brick wall and the plaster. The balconies are generally wood frame supported by wood or cast iron columns. In order to give the church a fitting appearance a false hanging ceiling (wire lath and plaster) is generally introduced over the church proper so as to hide the unsightly roof trusses. Several openings are to be found in this hanging ceiling to accommodate the central chandelier, the bell rope, etc. The stairways leading from the basement are for the *most part open* or in some cases in lath and plaster enclosures

Modern Fireproof Church.
An exterior view of an up-to-date fireproof church.

with wood doors. The roof may be covered with metal, wood or asbestos shingles or slate.

FIRE RESISTIVE CHURCH.

The fire resistive church commonly called fireproof is gradually making its appearance. The writer only a few days ago examined the plans of a very large fireproof church building about to be erected in our greater city and made many sug-



gestions in the plans, which, if complied with, would entitle the structure to the lowest possible insurance rate.

In this class, the exterior walls are either brick or stone and the floors and roof either concrete, terra cotta or other approved fire resisting material supported by steel members, the latter properly protected with at least two inches of concrete or terra cotta. The stairways and other floor openings should be enclosed in fire proof shafts with at least kalamein doors hung to iron frames. The balconies to be of concrete or terra cotta floor slabs supported by iron columns properly insulated and the fronts of balconies to be of incombustible material. If any wood finish (such as flooring, etc.) is used it should be laid without air space. The inside walls should be plastered direct without furring (see sketch).

One of the prominent fire proof churches in our city is built as follows: The floor of the church consists of vaulted concrete arches resting on brick walls while the entire ceiling is built of self-sustaining brick arches and ribs, the filling in of the ceiling being done with flat tile laid in three courses, breaking joints

FIREPROOF ARCH CEILING.
Note the groined arches from the scaffolding.

so as to form monoliths. The accompanying photograph shows a view of a groined ceiling from the scaffolding of a fireproof church while in course of construction. The towers are of brick and stone corresponding with the exterior walls of the church.

OCCUPANCY OF THE CHURCH.

The inspector who knows his business will first go to the highest point of the church and then work down. Some churches have an attic or concealed roof space. There, may be found a "catch all" for old records, furniture, etc., or, on the other hand, it may be scrupulously clean, with only the ventilating apparatus, consisting of metal ducts connected with a fan and a small motor. If a motor is employed it should rest on a metal drip pan and a self-closing waste can should be in close proximity to take care of oily waste used to clean the same. Then we descend to the balcony and inspect the organ. Sometimes behind the organ there is a swinging gas bracket, which should be made stationary and protected by a wire cage, although electricity is the only safe light to recommend.

If a motor is employed it should be installed as mentioned above. Then we descend to the church floor proper, where we find the altar and the pews and we note whether the seats or benches are of wood and upholstered and permanent or of a movable design. Then comes the basement of the church, which may contain some very severe hazards, a few being as follows: 1. The boiler room. 2. Storerooms containing combustible materials of all kinds. 3. Fully equipped stage for amateur theatricals. 4. Gymnasium. 5. Kitchen with range.

THE WORST HAZARD.

The most hazardous feature is the heating apparatus and a great many fires have been caused by the janitors forcing the fires during cold weather. Churches remain idle the greater part of the week and get as cold as a barn and then at the last moment on Saturday toward dusk the poor janitor forces the boilers or furnaces to their utmost capacity in order to have the church warm for the Sunday morning service. The New York Board of Fire Underwriters appreciate this hazard and have performed excellent work and greatly reduced the fire record of churches by their system of periodical inspection of all heating apparatuses. If steam heat is used the boiler, even if "low pressure," should rest on a concrete base and be enclosed in eight-inch common brick walls with a self-closing lock-jointed fire door at the opening, and if possible the ceiling above should be of fire-resisting material, i.e., concrete or terra cotta on steel beams. The smoke pipe of boiler should enter a common brick chimney with walls at least eight inches thick and lined with terra cotta. All steam pipes should be at least two inches from all woodwork unless they are protected with metal sleeves or

INTERIOR OF A CHURCH.

The highly ornamental decorations and fittings are very susceptible in case of fire.

collars, in which case the distance should not be less than one inch. Hot water heat is subject to practically the same requirements as steam. If hot air furnaces are used, the registers placed in any woodwork or combustible floor shall rest upon stone or iron borders firmly set in plaster of paris or gauged mortar. All register boxes used in any such heating system

shall be made of tin plate or galvanized iron with a flange to fit the rabbet in the border. The register box shall be enclosed in a tin or galvanized iron casing turned under the border and spaced at least two inches from the sides of the box; such casing shall extend from the border to and through the ceiling below in the case of a floor register and through the partition in case of a wall register. When a register box is placed in the floor over a portable furnace, the space on all sides between the casing and the register box shall be not less than four inches.

Every hot air furnace shall have at least one register without valve or louvers. The horizontal metal hot air ducts should be at least six inches below the combustible ceilings and no duct shall be placed in any floor partition or enclosure of combustible material unless it be at least eight feet distant in a horizontal direction from the furnace. The cold air duct should be entirely of metal. The furnace should be set and enclosed the same as the boiler mentioned above. If the ceiling above the furnace is of wood or other combustible material there must be a space of at least four feet unless the furnace is brick set, in which case the distance may be thirty-six inches. If the wood beams of ceiling above are covered with metal following the contour, the above distances quoted may be reduced one-half.

WHAT THE INSPECTORS SOMETIMES FIND.

Makeshift heating devices of all kinds are sometimes to be found. In some of the very old churches the "old style" pot coal stove appears as a "relic of the past" with its long winding smoke pipe, perhaps leading to an earthenware chimney so constructed that the smoke is lodged into the attic space instead of above the roof. Then again it may be the "old fashioned" sheet iron hot air furnace with a wood cold air box, the circular metal sides badly rusted and setting on a wood floor, with only about six inches distance from the top of the furnace to a wood ceiling. The ducts from the furnace rest against the wood floor where passing through the partitions, and all the register boxes are arranged for closing, instead of the principal register being fastened open.

THE LIGHTING OF THE CHURCH.

In little country churches kerosene lamps may still be found and in some of our larger city churches gas light with its many swinging gas jets still remain with us, but the up-to-date church is now lighted by electricity with the electricity supplied from the outside, the main distribution box being sheet metal lined with slate, the interior being properly equipped with blow-out fuses. The power should be arranged to be turned off at night.

MEMORIAL WINDOWS AND DECORATIONS.

Inspectors should carefully note the interior decorations and paintings and notify the office if they are permanent, i.e., painted

directly on the walls or merely hung to the walls, also the number of memorial windows, the size and workmanship, i.e., in leaded glass parts, etc. Underwriters prefer not to write insurance on these susceptible parts without getting some of the building insurance. Marble statuary set in the walls, although just as susceptible as the contents, are insured along with the building.

PROTECTED FROM EXPOSURE.

This illustration shows the value of fireproof architecture in protecting historical monuments. When there was danger that the Old South Church at Boston might be sold and torn down to make way for commercial improvements, the state of Massachusetts purchased it. Now a fireproof office building has been erected on the two most exposed sides.

THE ORGAN.

Insurance on the organ is not usually accepted unless the company is getting part of the building and other contents. A little water and smoke will practically put an organ out of commission. Some of the up-to-date organs are now enclosed on all sides and top (except front) in tile walls with double air space, and while this arrangement is very good from a fire viewpoint, the object is to guard against dampness only.

The altar and chancel rail are usually of combustible material

and in some churches many lighted candles are used during the services. Long steel rods topped with damp sponges will be found very effective in putting out a candle which has toppled over and is starting to burn speedily.

FULL FLEDGED STAGE EQUIPMENT.

Some of the churches have in their basements a stage which were it not for the size would make Belasco blush. Amateur theatricals are very common in some of the churches. The careful inspector will ascertain the construction of the proscenium wall, the kind of curtain, the number of sets of scenery, quantity of properties and where kept, the kind of lights used (i.e., foot, head and side lights), number of dressing rooms, location and construction, and devices used for curling hair, heating makeups, etc. The permanent stage feature is not as bad as the temporary one in that the latter requires storage of loose lumber, which is usually stored under the platform, and because of the carpenter work every time an entertainment takes place.

GYMNASIUM.

This feature is hardly worth mentioning. except that sometimes the floors are oiled, in which case the mops should be carefully guarded and the young men should refrain from taking just a puff from a cigarette.

KITCHEN.

This apparently harmless little feature has been the cause of several fires known to the writer. Some churches during "Fair" times work the badly worn-out gas range quite steadily, and either leave the gas turned on and some one lays something over the flame or perhaps grease from the frying pan overflows on the flame.

FAIRS.

As a general rule churches hold an annual "fair" in the Sunday-school room. At this time the fire hazard is considerably increased on account of the flimsy paper and cloth draperies festooned from the ceiling (sometimes near open gas jets) together with a miscellaneous stock resembling a 5 and 10 cent store.

STOREROOMS.

These rooms, containing old wooden pews, doors, trim, paint pots, etc., should be cleaned out and kept clean. The barrel containing "church oil" is not a serious feature if no sawdust is used to catch the drip.

MOVING PICTURE BOOTH.

If moving pictures are shown occasionally in the Sunday-school room the hazard is practically nil, if the machine is of

the latest type and enclosed in a booth approved by the Fire Prevention Bureau.

FIRE PROTECTION.

At every convenient point a few filled fire pails should be installed, together with a three gallon soda and acid type labeled fire extinguisher and a one-quart labeled fire extinguisher (such as J. M.) to be used for an electric or grease fire.

IN CONCLUSION.

If the church proper communicates with any other buildings, such as the rectory, parish house, etc., it should be cut off by labeled automatic fire doors. The fire record of the ordinary church could be greatly improved and if the suggestions mentioned are heeded the writer has every reason to believe that churches can be made desirable fire risks and underwriters will be anxious to get them on their books.

COLLAR AND LAUNDERED SHIRT FACTORIES.

The Hazards of an Important Industry.

By T. C. Naulty, District Secretary and Inspector, Underwriters' Association of New York State.

Separate collars for men's shirts were first made in this country in the year 1825, in Troy, by a blacksmith's wife, who did the family washing and realized that shirts with separate collars would not have to be washed as often as did shirts with collars attached. The industry of collar manufacturing, which originated in Troy, has grown to such an extent that the shirt and collar factories of that city employ about fifteen thousand people and manufacture about 80 per cent. of the total collar output of the United States and about 40 per cent. of the laundered shirt output. The annual wages paid to workers in this industry in Troy total over five million dollars a year.

The first shirt factory in the United States was started on the corner of Church and Market Streets, New York City, in 1832, and while the industry first grew to large proportions in the city of Troy, to-day, through the less expensive class of foreign-born help employed in New York City, a high percentage of the soft, unlaundered, negligee and work shirts and collars are made in that city. The manufacture of shirts and collars is purely a home industry for this country, as the total value of the imports for both of these classes for the year before the European war was only $70,000, against a valuation of goods manufactured here of $20,000,000 in collars and cuffs and about $90,000,000 on shirts. The exports of these two industries before the war totaled to 6 per cent. of the output, or approximately $6,500,000.

PROCESS OF COLLAR MANUFACTURING.

The material used in the average collar, retailing for fifteen cents apiece to-day, is of cotton, although one factory in the vicinity of Troy claims that they still use linen for the front. Most of the collar factories receive the cotton from the mills bleached; but several of the larger plants buy it "in the gray," and do their own bleaching. The bleaching process is done in separate and distinct buildings not in conjuncture with the main factory.

The cotton comes to the factory in webs twenty-five yards long, which are unwound and carefully examined for any imperfections in the cloth. After this examination the webs are placed in

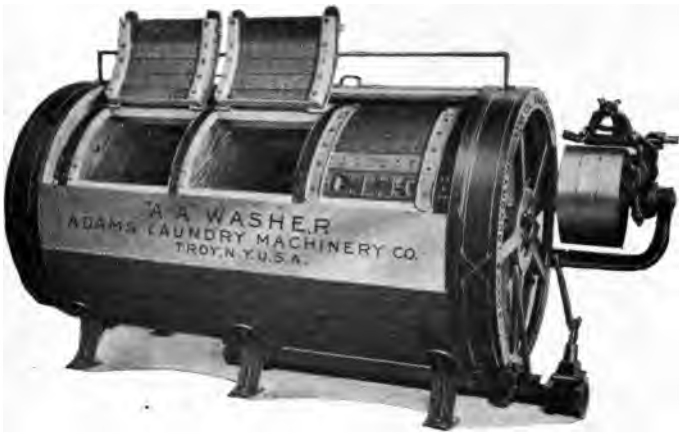
vats of distilled water heated to a certain degree and left there for a period of forty-eight hours or more.

The cloth when removed from the water is festooned over horizontal bars, which are joined on each end in the manner of an endless chain. These bars on tracks are moved into wood, metal lined, dry rooms heated by live steam at a very high temperature. The cloth on the bars is kept in a swaying motion in

Collar Shaping Machine

the dry rooms by the moving to and fro on tracks, this being done to insure uniform shrinking. When the cloth is dry it is carefully measured and inspected to see that the proper amount of shrinkage has taken place. If the shrinkage is unsatisfactory, it is returned to the vats for a recurrence of the process. The cloth that is thoroughly shrunk is folded in a folding machine and is ready for the cutting.

The style of collar in the greater use to-day is the "turn-over" or "banded" type. The manufacturers class this type in two parts, the top and the band. The part of the collar exposed to view when worn is the front of the top, the back of this being the facing of the top. The "back" of the band is the side worn next to the neck, and the "front" of the band is the side next to the top. The ordinary "turn-over" collar consists of seven pieces, four in the top and three in the band. There are three and sometimes four grades of cotton used in the make-up of the collar. The front of the top is the best grade obtainable and is sometimes linen, while the side worn next to the neck

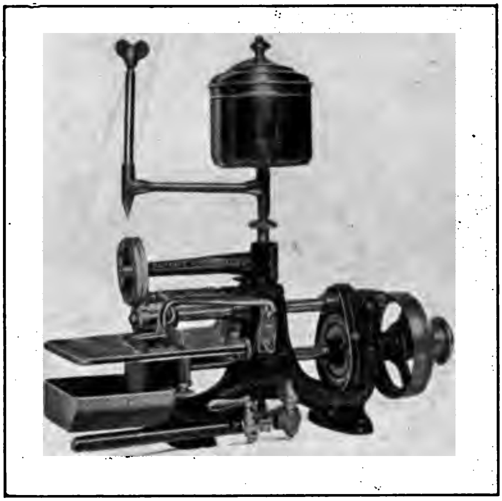


WASHING MACHINE

is a second grade and the interlinings are usually third and fourth grades.

The cutting rooms contain long wood tables, the tops being made of soft pine blocks. The cloth is brought from the shrinking rooms and placed in piles on the tables in plies forty-eight thick. The cutting is almost universally done by hand, as it has been found that more collars can be obtained from a web of goods by this method and that there is less waste. The cutters use wood patterns, mostly of maple, and a very sharp, short-bladed knife. The men employed in this work are classed as "skilled labor" and cut on an average of two hundred and twenty-five dozen collars a day. After the cutting, the collars are tied in bundles and the size, style and lot number stamped on the outside of each bundle.

The pieces to be used for the backs of the bands are then printed in an ordinary printing machine with the name of the manufacturer, the size, the style, the lot number and the trade mark.



COLLAR SEAM DAMPENER

TURNING.

Most of the ordinary priced collars are now machine turned, but the higher priced ones are still hand turned. In the machine used for turning, the bed plate is heated by steam coils or gas. The pressing dies are so arranged that when the five to seven plies in the collar are put on the bed plate the edges are turned to a certain width and at the same time the plies are pressed on the heated bed plate so that they remain folded togeher. The pieces making up the collar remain folded together until ready for stitching, after which the facing is taken off and reversed, leaving the edges turned on the inside.

STITCHING.

The stitching is done on sewing machines run by power, usually electric, one large motor running a long line of shafting under the sewing tables. After the edges are stitched together the inserting is done.

INSERTING.

The inserting is done on a long stitching machine, which joins the top and the bands together.

BUTTON-HOLING.

The button-holing machines are run either by small individual electric motors or foot power and are of two types. One type

stitches the button-hole first and then a steel edge descends and automatically cuts a slit between the two rows of the stitching and at the same time cuts the thread. The other type, more universally used and especially by manufacturers having patented types of button-holes, has a steel die, which cuts out the hole and a needle stitches the thread around it at the same time. The thread is automatically cut in some machines and in other cases by a small, sharp knife in the hands of the operator. Usually a separate operator puts in each of the end button-holes and the middle one.

The turning and button-hole machines are the most complicated in use in the factories and the ones less readily replaced. Both of these types of machine are under existing patents and many of the collar manufacturers have to pay a royalty based on the number of collars that go through the machine.

WASHING AND LAUNDERING.

Before the collars are sent to the laundry they are tied through the button-holes with a string into bundles of a dozen each. When the collars reach the wash room they are put in barrels containing water and soap and are allowed to soak for about twenty-four hours. The action of the water and soap loosens all dirt and grease which they have accumulated in the shop. They are then put in the washing machines, which are usually of wood construction, cylindrical in shape, and in which there is an inner cylinder divided into pockets, into which the collars are placed. The walls of the inner cylinder are perforated so that the soap, water and washing fluids that are placed in the outer cylinder go through these holes as the cylinder revolves and thoroughly wash and cleanse the collars.

As in the washing some bleaching powders are used, acetic acid is placed in the washing machines to neutralize the bleaching process. The blueing is added in small quantities and the collars are then examined by daylight to ascertain whether they are the proper color. This is the important part of collar manufacturing and rooms are fitted up with lights imitating daylight as near as possible for use in stormy weather.

After the blueing process, the collars are placed in extractors, which are the shape of a tub and have an inner basket of copper, which revolves at a high speed. The collars are thrown against the side of this basket and the pressure exerted extracts most of the water. When taken out of the extractors they are dampened just enough for the starching process.

The strings holding the collars in bundles of a dozen each are then removed and they are placed on an endless apron, which passes through a receptacle filled with boiling starch. This machine is called the starching machine and is usually heated by gas. The starch is thoroughly squeezed into the collar and the

surplus wiped off, usually by hand, the operator smoothing the collar with the front and back of the hand. The collars are then placed in racks in steam-heated dry rooms. The dry rooms very in different plants. Some are of fire-proof construction with standard metal-clad fire doors and others are entirely of metal

EXTRACTOR

construction; but the more numerous are the ordinary Troy dryers, of wood construction, lined with metal.

After the collars are thoroughly dried, they are put into metal-lined boxes called "sweat boxes," and left there for twenty-four hours. The collars are then dampened by running through a machine containing water-soaked aprons and they are then sent

to the ironing machines, which consist of large steel rollers covered with cloth, run by electric motor and heated by gas. In the "turn-down" collar this process makes a fine finish on the outside of the collar, but the front of the neck band, which shows when the collar is worn, is not finished. This is done in a machine called the "tipping" machine, which has a gas-heated metal plate about six inches square and a square cloth foot, which

COLLAR DAMPENER

automatically rises and falls. This machine gives a uniform finish to the front of the neck band the same as the outside of the collar itself.

The next process in the "turn-over" collar is the dampening along the line of the crease before it is folded. This is done by running the collar under a small revolving wheel kept wet by a supply of water which is fed upon it. The collars are then

folded over and smoothed by hand. They are then put in the shaping machines, which shape them in a circular manner by gas-heated drums. The collar is then ready for final inspection before being boxed. Those which are defective in any way are thrown out and sent to the salvage department.

INSPECTIONS.

At this point it is well to call attention that in each of the above-named processes the collar is inspected. The operators are paid a bonus on the basis of the number of errors or defects they find in a collar. The approved collars are then boxed and

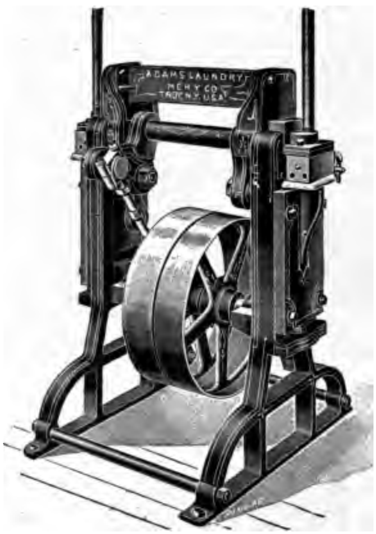
DRY ROOM

wrapped ready for shipment. The collars which are thrown out and sent to the salvage department are gone over for grease spots and any imperfections that may exist. This department handles cleaning fluids and fixes up those collars which can be sent out. Those that are defective are thrown aside, the name of the maker stamped out and they are sold as "seconds."

Most of the larger collar factories manufacture their own pasteboard boxes as well as their packing cases, do their own printing, color work for advertising and maintain their own repair shops for repairs to the machinery.

SHIRT MANUFACTURING PROCESSES.

The first process in shirt manufacturing is the pattern making. The patterns are made of heavy manilla paper and are marked indicating style, number and size. The materials used in the manufacture of men's laundered shirts are madras, percale, pure flannel, linen, silk and silk mixtures and mercerized cotton.


Tipping Machine

CUTTING.

The cutting room contains long tables on which the bolts of cloth are stretched out, or known as "laid up" from one end of the table to the other in as many thicknesses as required.

MARKING OUT.

After the material has been laid out, the markers, who are skilled cutters, place the patterns on the top layers of cloth and press the outlines with black chalk.

The principal parts of the shirts are fronts, bosoms, backs, sleeves, yokes, cuffs, neck bands, collars and pockets. Much skill is required in laying out the patterns in order to waste as little of the material as possible. The cutters use short-handled knives similar to collar cutters, the work on the better class of shirts being done in this manner. In some of the cheaper grades electric cutting knives are used.

SORTING AND BUNDLING.

The various parts of the shirt are then assorted and tied up in bundles of required sizes and lots. The assorters mark the size, lot number, sleeve length, neck band and other parts so that they may be promptly identified in the sewing and shipping departments.

SEWING ROOM.

The shirts are now ready to be sewed together and this is usually done by electric power sewing machines, one large motor running from eight to one hundred machines. The operation

consists of first the shirt being stitched around the bottom by hemmers and then sent to the front makers, who sew the center-pieces and pockets on. The yokes are made by separate operators, who also attach the labels. The backs are then joined to the yokes and then the backs and fronts are stitched together.

NECK BANDS.

The neck bands usually consist of two pieces of material with a lining between and a small strip for button-hole reinforcements. After the neck bands are attached to the shirt the two parts of the sleeves are seamed together and the cuffs stitched

COLLAR IRONER

on and attached to the sleeves. The button-holes are made by foot or electric power machines similar to the collar machines, this being done before the sleeve is attached to the shirt. The sleeve is then attached to the shirt by stitching into the shoulder socket and the same operation usually stitches the sides of the shirt together. The button-holes are made in the facing of the shirt by a machine similar to the collar machines. The buttons are attached by button sewing machines run by electric or foot power.

LAUNDERING.

Before the better grades of shirts are laundered they are put in large vats containing soap and water and in some cases chemicals. These vats revolve by machinery and thoroughly soak the contents. This performs not only the shrinking process, but it is a good test for the dyes of the colored shirts. The shirts are next put into extractors and the processes of drying, dampening and starching are similar to the collar end. The better class of shirts is ironed by hand power consisting of small individual gas stoves and irons. The shirts are then thoroughly examined, and if found to be defective in any way, the label of the manufacturer is removed and they are sold for "seconds." The better class of shirts is usually put up in pasteboard boxes containing from three to six. These boxes, as well as the wooden packing cases, in the larger factories, are made on the premises. The larger plants also maintain machine shops for the repair of machinery.

CONSTRUCTION.

The factories which manufacture shirts and collars are usually sole tenant risks. The buildings are mostly of standard or semi-standard mill construction with brick walls and the stairways and elevators in brick towers cut off by standard fire doors. The boiler houses are usually cut off from the rest of the risk in a standard manner. In the larger concerns electric power is used throughout and the power is generated on the premises by dynamos run by steam engines. The factories that are exposed are usually protected by standard fire shutters on exposed sides or by wire-glass windows. In some of the new additions to the larger factories fire-proof construction is used.

COMMON HAZARDS.

The majority of the plants use electricity for light and power, many generating their own electricity. Direct current and electric motors run most of the machinery. In the sewing department one large motor will sometimes run from eight to one hundred machines. The heating is by exhaust steam from the boilers with steam pipes arranged along the sides of the wall or steam radiators. The steam pipes are usually protected where they pass through the wall. The boilers are usually of the horizontal type, brick, set in detached boiler houses. Most of them have stacks built from the ground and are well ventilated. Where metal stacks are used I found that the woodwork of the roof was well cut away and protected by metal ventilating collars.

SPECIAL HAZARDS.

The special hazards consist of the dry rooms, which are heated with live and exhaust steam. The steam pipes are arranged on the floor of the dryer in some cases and are often run vertically

along the inside of the dryer. Where wood dryers are used, they should be metal lined and the woodwork should be protected where the steam pipes enter the dryers, and the steam pipes themselves should be enclosed in wire-mesh screens, so that the clothes falling from the racks would not come in contact with the steam pipes. Some of the dryers are equipped with a live steam jet with an outside control valve, which is a good idea, for in case of fire within the dryer, the live steam could be turned on from the outside and the fire suffocated.

The mangle irons and individual stoves for irons are usually gas heated. Care should be taken to recommend removal of any rubber or flexible metal tubing on gas connections. All connections should be of metal pipe and made rigid. The old-fashion cylindrical coal heated stove for irons are practically extinct. The gas supply to the laundry and turning machines should be so arranged that gas supply for all machines and irons could be shut off by one valve when the factory closes for the night.

Wood boxes should be provided in the cutting rooms of both the shirt and collar departments, for placing clippings. These boxes should be emptied nightly and the clippings on the floor should be swept up and removed to a storage room provided for the purpose and baled. In most factories this is done, and I found that these clippings are sold at an average of six cents a pound and are shipped out at least once a week.

The turning, pleating and creasing machines are all gas heated and involve no special hazard except if the material were allowed to remain in the machine while not in operation. This is very unlikely and I have not heard of any fires occurring from this cause.

Printing names, trade marks and sizes on collars and shirts is done in ordinary flat bed presses run by individual motors usually. It should be noted what fluid is used in cleaning type and if volatile in nature, whether it is used from approved safety cans and also where the main supply of fluid is kept.

Machine shopt for repairing involves usual hazard of power machinery. Tool forges should be properly set and vented into chimney or outside building. Wood working in making boxes should be in a building cut off from factory, if possible, and proper saws and planers should have blower system venting into shavings vault outside of building. Where blowers are not provided, floors should be kept clean and shavings removed daily from the building.

In the pasteboard box making, the glue or paste pots should be heated by steam or gas, with metal under stoves and on floor to catch any overflow from the pots. Clipping bins should be provided and the floors cleaned up daily and the clippings baled and placed in a room for that purpose. They should not be

allowed to accumulate in large quantities and should be removed from the factory at least once a week.

PROTECTION.

In most of the collar and shirt factories of any size automatic sprinkler protection is installed. All risks should be equipped with at least 2½-inch standpipes with connection on each floor in each fire section, with sufficient linen fire hose of at least 2 inches in diameter with five-eighths-inch nozzle to cover the floor area of the fire section. In addition, a proper supply of either three-gallon approved chemical extinguishers or filled fire pails should be scattered around on each floor.

Most of the plants to-day have a watchman making at least hourly rounds, nights, Sundays and holidays and at all times when the plant is not in operation. Watchman should be checked with a time detecting system, either an approved portable or magneto clock, and stations should be so arranged that all parts of the factory will be patrolled.

SUMMARY.

The average collar and laundered shirt factory is considered an excellent risk. The history of fires in the vicinity of Troy in the last ten years shows a very good loss ratio on the class.

The nature of the business necessarily means strict cleanliness throughout the plant, as the product naturally has to be spotless when offered for sale.

The management is usually efficient, as the margin of profit on the product is so small that the larger factories owe their size to methods of management.

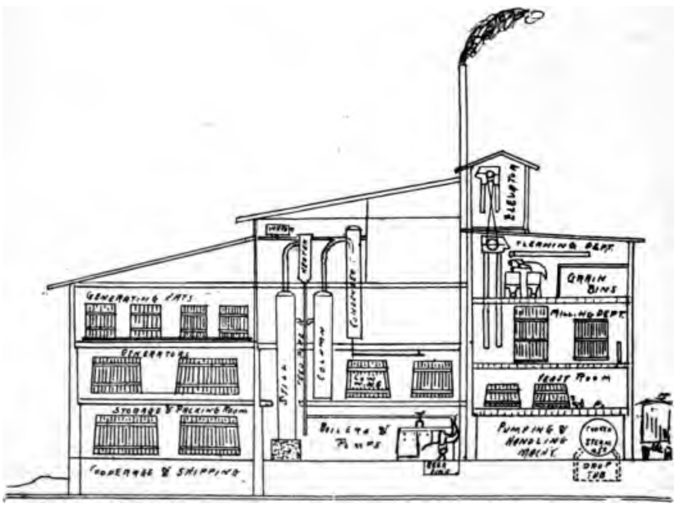
The principal hazards, I believe, are the care of the clippings, the drying and ironing, and the incidental process of printing and paper and wood box making.

VINEGAR FACTORIES AND PROCESSES

Methods and Hazards of Production—Bad Housekeeping the Main Danger—Grain Handling Important Element

By Oscar A. Smith, Memphis, Tenn.

This industry is a large one in the United States, yet very little information regarding the factories and the methods of manufacturing have been published in such form as to be available for the lay public and the insurance interests. Of course the vinegar brewer can find such information as he needs in



FARINACEOUS VINEGAR FACTORY.
(Section.)

technical works on the manufacture of alcohol and the manufacture of acetic acid. When the novice begins to look for information it is not to be found in such quantity as to be of any benefit. In fact all that is published on this subject is so restricted as to give very meager information.

Among insurance men vinegar factories have a bad reputation. How they have acquired it is quite difficult to ascertain. That they deserve such is doubtful. When the processes and hazards are fully known it is doubtful if all classes of vinegar factories will be retained on the restricted or prohibited list. It is probable that the lack of information regarding the classes has caused this trouble. Another reason is the confusion of the reduction plants with true vinegar factories.

A reduction plant is one in which 100 grain vinegar is cut by the addition of water and caramel coloring matter until it is only 20 grain vinegar. These plants are usually housed in flimsily constructed frame and iron-clad buildings which deteriorate rapidly. Then a moral hazard often attends, which results in fires. Thus an industry deserving a good reputation is blackened by an attendant business.

Commercial vinegar is all made by the so-called quick vinegar process. This is in contrast with the lengthy process by which the vinegar was formerly made from cider on the farm, and especially in days now long past. A quick vinegar factory is a distillery with the acetification process added. The base of all vinegar, no matter how manufactured, is alcohol. Alcohol is not found in natural state in any substance, but may be made from all substances which contain sugar or sugar bases in some form. It is the product of the decomposition by fermentation of the saccharine principles contained in these. It is produced either from raw farinaceous materials containing starch—as potatoes or grains, or sacchariferous materials containing sugar —as grapes, beets, sugar cane, molasses—and may even be made from sawdust.

This being true vinegar factories may be divided into two classes:

A. Farinaceous.

B. Sacchariferous.

FARINACEOUS FACTORIES.

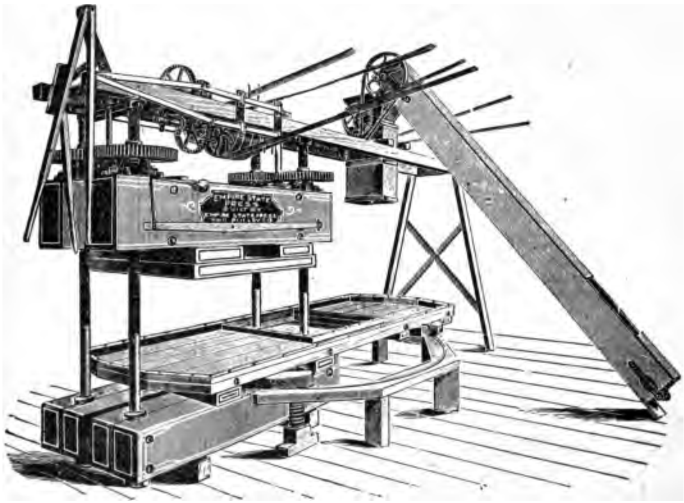
With the first class it is necessary to first convert the starch into some form of sugar from which alcohol is produced by fermentation. Many methods are used in preparing the farinaceous materials for fermentation, but all use at least two of the following operations:

Grinding.
Gelatinizing.
Steeping or Steaming.
Mashing.
Saccharifying.

Attrition mills are usually used to reduce the grain to a flour in order that the starchy interior may be easily acted upon by the saccharifying principle. If it is to be mixed with malt

later, it is not necessary to reduce to as fine a flour as when a slightly different process is used which calls for steaming or steeping.

For each 100 lbs. of grist eighteen to twenty-three gallons of water at 131° to 140°F. are introduced into the steamer. As the stirring apparatus is set in motion the grist is slowly poured in. After nearly half of the grist has been introduced, about 1 to 1½% of ground malt or crushed green malt is thrown into the apparatus, and the remaining half of the grist is then added. The contents of the apparatus are now heated to the cooking temperature in about twenty minutes. The steamer is closed



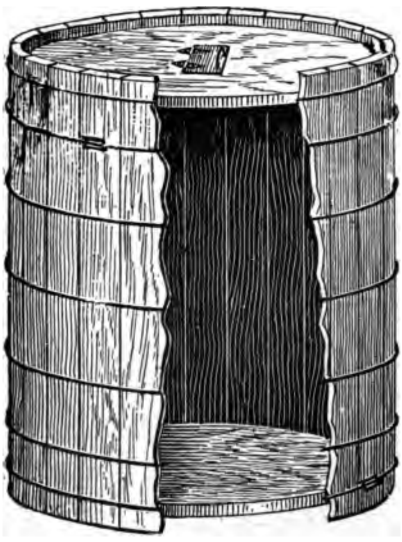
VINEGAR PRESS.

and the steam pressure is gradually raised, so that in twenty minutes it is one atmosphere, in 40 minutes two atmospheres and in one hour three atmospheres (45 lbs.). The mass is allowed to stand at the maximum pressure for about 10 minutes and is then blown out. If the grist is less finely ground, the steaming process is somewhat longer. This process usually prepares corn so as to produce about 4.5 gallons of alcohol to 100 lbs. of corn—and more of low wine which is used in the manufacture of vinegar.

This steeping or steaming reduces the mass to a gelatinous substance ready to be acted upon by diastase, a very active

ferment having the property of reacting upon starchy matters, converting them first into a gummy substance called dextrine, and then into glucose or grape sugar. This action is very remarkable—50 grains being sufficient to convert 220 lbs. of starch into glucose (sometimes called maltose). This is then converted into alcohol by breaking up the sugar atoms (containing carbon, hydrogen and oxygen) into carbonic dioxide and alcohol (C_2H_6O) by the process of fermentation which is started by yeast, a fungous growth.

This yeast is either wild (from the air) or cultivated. If the mash is left to stand under proper condition the wild yeast spores in the air will soon settle on the mash and begin to multiply. This is the method ordinarily used in the cold process of making vinegar. On the farm it has been made for years from cider by allowing the yeast spores in the air to collect upon the surface, or by the introduction of spores from other fermenting fluids. It is quite often found that in addition to the friendly spores, antagonistic organisms attack the fluid and check proper fermentation. Consequently, it has been found to advantage to exclude the air spores and use cultivated ferments in converting the maltose into alcohol.



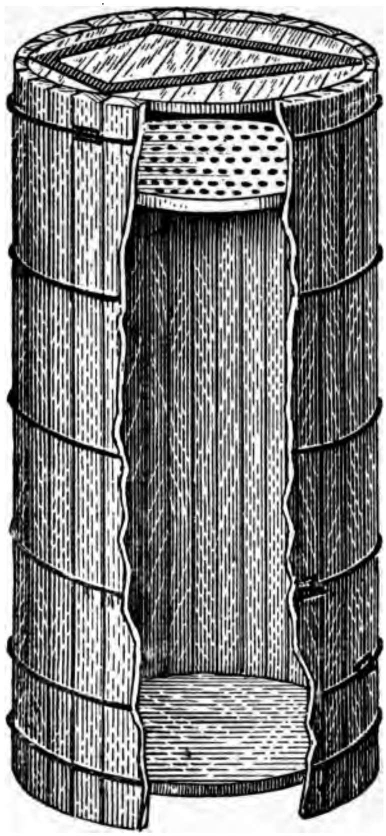
GENERATOR.

This yeast is cultivated from a mother bed in a special mash, and when ripened to the proper stage is mixed with the mash in the fermenting vat. At a temperature of 50° to 86° F. the yeast induces fermentation converting the sugar of the mash into carbonic dioxide which escapes and alcohol which remains in the decomposed mass.

The process of separating the alcohol from the mass is accomplished by distillation when low wine is desired to be used as a base for vinegar.

This fermented mass is placed in the still, which is usually heated

by steam and the alcohol, having lower vaporization point than water, rises as a vapor and is conducted through pipes into a collecting vessel after having been condensed by the reduction of the temperature. These still vary in form from a very simple device to elaborate machines which sometimes reach through two or more floors. This alcohol, which is really only about 25 to 30 proof spirit and the balance principally water, is called "Low Wine" on account of the low percentage of alcohol.



TANK.

It is then put through the acetification process somewhat after this manner. Large tanks with false bottoms and tops are filled with beech shavings, straw, cork or other fibrous or woody substances which have been treated with acetic acid, or by the introduction of bacteria which propagate acetic action upon low wine. The bacteria or ferment is either mycoderma or mycrococcus aceti, without which air alone, which is indispensable, cannot act. An essential condition for the life of the ferment is a temperature of 67° to 87° F. The low wine is allowed to trickle slowly down through the soured or acetified shavings. The action o these acetic bacteria, together with oxydation, breaks up the low wine into vinegar. The chemical equation for this action is $C_2H_6O+O_2=C_2H_4O_2+H_2O$.

Some plants run the low wine through several tanks before

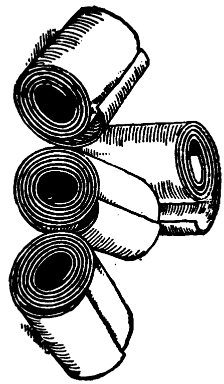
the conversion is complete, while others, keeping the acetification up to full strength, make 100 grain vinegar by running it through only one generator. To make the vinegar in either case successfully, there must be:

1st. Acetic ferments.

2nd. Presence of air.

3rd. Temperature of 67° to 87°.

4th. Alcoholic liquid containing the elements necessary for the life of the ferment.



SHAVINGS.

Vinegar is a substance endowed with hygienic properties dependent upon the composition of the liquid from which it is formed. In addition to acetic acid there should be organic salts, inorganic salts, which give the bouquet, glycerine and a small proportion of alcohol, in reality, all the elements which constitute the original liquid.

HAZARDS OF FACTORIES.

The hazards of the manufacture of vinegar may be made serious without the proper care, just as bad housekeeping in a distillery induces serious hazards. The multiplicity of processes and machinery introduces a tendency to fires.

In such a plant the first hazard is that of grain storage and grain handling. The storage rooms or bins are usually on the fourth, fifth or sixth floors of the building. To get the grain to these bins it is necessary to have elevator shafts, boots, heads, spouts, belting and open belt holes with the usual accompaniment of dust, hot boxes and communicating floorway openings.

The elevator and mill *must* be kept clean, and a man must be on duty in the top whenever the plant is running. The mill must be in charge of a competent miller—there is a heavy mechanical hazard in such mills and elevators connected with vinegar factories. Bearings must be kept clean, chokes in the grain or stock elevators must be discovered at once or a fire will follow. In fact the very first process introduces the chief hazard of the plant. As no grain is free from trash, dirt and vegetable dust when it is received at the plant, it is necessary to run it through the cleaning machines either before being stored in the bins or before being ground or malted.

Mechanical cleaning of grain produces large quantities of dust which is liable to explode on contact with a naked light. Consequently, the hazards of this class of work are those of a feed mill or grain elevator. These may be serious or they may

be safeguarded in such a way as to minimize the danger of fire to a certain degree. Any vegetable dust in finely divided state is subject to explosion caused by sparks. Flour dust is most liable to explode. Clouds of dust, spreading in all directions and filling the entire works may be produced when large quantities of flour are shot down chutes or by the falling or bursting of sacks. In such event any small hidden flame may ignite the whole explosive cloud of dust.

Grain and seeds are subject to spontaneous decay and heating, though less liable to spontaneous ignition. But this same grain when reduced to finer particles, or when deprived of one or more of its constituent substances, is given a greater tendency to heat or take fire spontaneously. Consequently, conditions which do not greatly favor the development of spontaneous ignition in grain while intact, become more likely to foster it in supplementary constituents.

The attrition mills, unless protected by magnets, introduce danger of spark fires from foreign substances in the grain. Bearings must be cared for and accumulations of dust removed. Hot bearing detectors should prove effective.

The cookers must be protected in such a way as to avoid contact of steam pipes with woodwork. Safety valves to regulate the pressure of steam must be used.

The fermenting tanks do not introduce serious hazards. These require frequent cleaning and whitewashing inside in order to keep them from souring and ruining the mash. The stock of lime for this whitewashing should be in a house detached from the plant, otherwise some danger will exist from slaking lime. To prevent decay, the exterior is frequently varnished or painted with asphaltum paint. These tanks are heated sometimes by steam pipes. This is not dangerous except from contact with woodwork. But the greatest danger comes from the heating system used in keeping the temperature of the fermenting room regulated. Frequently gas stoves with flexible tubing are used. Also kerosene oil stoves are frequently used. This is a dangerous method, and should be avoided if possible.

The still, if not fire heated, does not introduce serious hazards. Of course the pipes furnishing steam for the still should be free from contact with the woodwork. The low wines resulting from distillation in vinegar factories are not inflammable or volatile enough to the susceptible to fire.

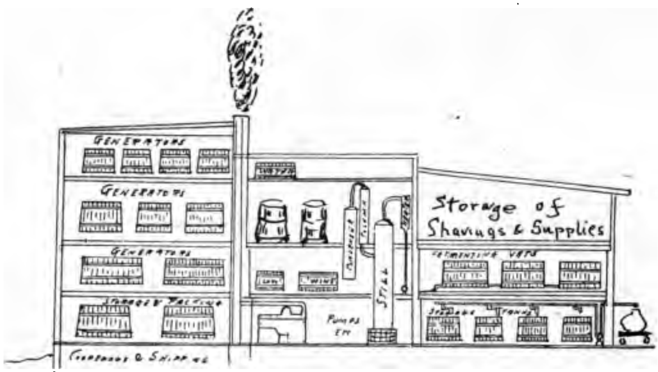
The laboratory, if handled with ordinary care, is not liable to cause fires. The few chemicals used are not of such a nature as to be specially dangerous, although it will be well to see that proper attention is given to the care of the carboys of sulphuric acid that are invariably on the premises, being used to regulate the acidity of the mash.

The generating rooms present zero hazards as to fire if or-

dinary housekeeping is used. The tanks should be so arranged as to permit easy access to all parts of the rooms.

All vinegar factories have the coopering and recoopering hazards, together with marking and occasional painting of barrels. In most plants the barrels are lined with paraffine or glue to prevent leaks. These kettles should be steam-jacketed and no open flame used to heat same. Properly safeguarded this should not be dangerous.

Briefly recapitulated, farinaceous vinegar factories resolve themselves into a class that should not be specially dangerous if properly cared for and good housekeeping followed. Its operations divide into three classes, with the first as most serious:



SACCHARIFEROUS VINEGAR FACTORY.
(Section.)

1st. Milling and Storage.
2nd. Fermenting and Distilling.
3rd. Generating (Acetifying).

SACCHARIFEROUS FACTORIES.

In great contrast with the foregoing class of factories, stands the sacchariferous vinegar factory, of which may be taken a molasses vinegar factory as an example. Molasses is the uncrystallizable syrup which constitutes the residuum from the manufacture and refining of cane and beet sugar. The kind invariably used is a black molasses called "black strap." Containing about 50% of saccharine matter it is rich in fermentable matter. As this material is already in such form as to be easily started on the road to fermentation, no dust hazard

exists, no grain on hand to become a hidden danger, no attrition mills with their attendant ills.

Simplified, it is only a collection of fermenting vats into which molasses is run to be fermented. Of course this class has a boiler room and other common hazards, as do practically all plants using steam and/or machinery.

The molasses arrives at the plant in tank cars, the contents are pumped to large storage tanks or vats to be later drawn into the malting or fermenting tanks for fermentation. This molasses is then diluted with about eight volumes of water in order to hurry fermentation. If it shows an alkaline reaction, it is acidified with sulphuric acid, as fermentation is retarded by alkali present to any degree. A natural ferment, such as brewer's yeast, is added to shorten the process.

This usually begins in about eight or ten hours, and lasts upwards of sixty hours, when it is ready for the still. One hundred pounds (8 gallons) of molasses produces about five gallons of low wine. From this process onward, the operations and labors are the same as in farinaceous vinegar factories, and the hazard, except as to common hazards are about at zero. The processes and materials throughout are wet. No combustible matter is used and no inherent tendency towards fire is found.

The best comparison between the hazards of a farinaceous vinegar factory and a sacchariferous vinegar factory is shown in the two diagrams of vinegar factories representing each class.

Another example of the sacchariferous factory is the cider vinegar factory, which uses apples as the base. Here is a collection of high-speed machinery with its attendant hazards. The macerators run at a high speed and develop a certain amount of refuse. The presses are run by belting and the pumice from which the juice has been pressed collects about the place. Unless very good housekeeping is practised this division of the sacchariferous factories will be more susceptible to fires than the molasses vinegar factory. After the cider is made the remaining processes are very similar to that of the other factories.

The cider vinegar factory now has attendant processes connected with it in order to utilize the waste products and also to enable the plant to be operated throughout the year. The pumice, which formerly was burned in the furnace, dumped into the river or hauled out upon the fields as fertilizer, is now run through a drier and kept for use as a jelly base to be used after the grinding season. This is very rich in pectone, which is the base of jelly. When dried and finely pulverized it may be added to other fruit juices which are lacking in pectone and in this way a larger quantity of jelly produced. The cider may be barrelled and put into cold storage for later use in the manufacture of jelly and preserves. With it as a base by the addi-

tion of strawberries or peaches or other fruits may be made into a very creditable preserve and at a much lower cost than if only the fruit were used.

Still other cider vinegar plants operate pickle works in addition to the regular processes and some plants have all the processes. This is probably the reason underwriters, and especially those connected with the actuarial bureaus, have gotten the impression that the class is not a large one. They have rated them largely on the basis of judgment and not from actual experience—no experience tables having been kept because they were of the impression that the class was inconsequential.

Since 1914 vinegar plants have come into prominence for other purposes than just the preparation of foodstuffs. In the demand for materials for munitions was found a large outlet for acetic acid, which can be produced from 100 grain vinegar. Large plants have been constructed for this purpose on the seacoast—one especially large one at Baltimore, where the black strap molasses can be easily secured by shipload from the refineries and the cane fields of Cuba and Porto Rico.

There has also sprung up a heavy demand for this black strap for use in manufacture of alcohol for munitions. This has caused a great advance in the price of raw materials for the vinegar manufacturer. Consequently the vinegar manufacturer has had to secure greater efficiency in his plant in order to show profit. This may cause some plants to shut down unless they can get substitutes.

STABLES.

Comment on an Important but Decreasing Hazard—Various Types Classified—Safeguards Pointed Out.

By S. T. Skirrow, New York City.

At a large fire in "Hell's Kitchen"* not long ago a little rough urchin remarked, "What is it, fellers, a circus coming along?" The facts were that a stable was burning, and the firemen had placed bags over the animals heads so as to lead them down the outside winding runway and out into the street.

Stables furnish a hazard apt to be forgotten now that automobile garages are so common. While many former stables have been changed into garages, there are still a great many and occasionally new ones are erected. Quite often they will be found in congested districts "sandwiched" in between tenements and other structures, subjecting at times whole rows of buildings to a serious fire.

THE VITAL QUESTIONS ARE

(1) What must an inspector look for in such risks?

(2) What does an underwriter want to know to be able to pass good judgment on a line of insurance?

(3) What can we do to minimize the fire dangers?

(4) What is the best type of construction?

(5) What must be done to obtain the lowest insurance rate?

Questions Nos. 1 and 2 are in the same class and call for careful inspections and reports setting forth the facts clearly. Questions Nos. 3, 4 and 5 are closely related because the minimizing of fire dangers and the promoting of good construction serve to obtain the lowest possible rate. Because of the various standards of different rating organizations and so as to avoid technical details, we will not deal with the question of rates.

First let us review the kinds of stables with a brief definition of each.

Private Family Stable—This is perhaps the best that can be had and is one used exclusively by one family for housing of horses and pleasure vehicles. Usually the upper portion of the building is occupied for dwellings by the coachmen.

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* "Hell's Kitchen" is a section of the City bounded by West Thirtieth Street, Tenth Avenue, West Forty-second Street and the Hudson River.

Private Business Stable—This is one where the occupancy is that of a single tenant housing horses and business vehicles and run as part of or in conjunction with some regular business. This class would include stables run in conjunction with retail stores, breweries, dairies and large merchants. These are usually desirable as the conditions present are in most cases better than the ordinary stable because more attention is paid to care and maintenance.

Boarding Stables—These are commonly used by individuals or merchants for the boarding of their horses, carriages and wagons. In other words, the proprietor reaps a profit for assuming this care.

Livery Stables—In these stables, horses, carriages and wagons are kept for renting to others, and quite often they are run in connection with boarding stables. While not so desirable as a private business stable, they are a good second choice.

Riding Academy—This is usually an adjunct to a livery stable and consists of a large covered addition with tan bark floor for indoor riding. It can be placed in the same class as a livery stable.

Express and Trucking Stables—While similar to a private business stable, attention should be given to the kinds of merchandise apt to be stored on the premises overnight.

Contractors' Stables—Private business in nature, but usually filled with wooden forms and moulds, tools, machinery, etc.

Sales Stables—At these stables, usually only horses are kept and they are held for private sales or auctions. This is one of the most carelessly kept classes, mainly because the help employed is not of the best. The sporting trade and representatives of buyers frequent these stables smoking, etc. As a rule, there is not much interest in keeping these stables clean, because the horses are kept for a short time only and there is no pride taken in their up-keep and health as would be in a private business or family stable.

Veterinary Stables—In these stables, horses are doctored and treated for wounds, lameness, etc. The class can be likened to hospitals, for in case of fire, many of the horses will perish because some cannot be moved except with great difficulty. In some cases it will be found that horses are suspended from the ceiling by braces.

TYPES OF CONSTRUCTION.

Seldom will an inspector find a new building. Most are of the old type construction and many are constructed entirely of *frame,* of large areas and badly in need of repair.

FRAME.

The one and two-story frame stables are most prevalent, especially outside of city or fire limits. Usually it is considered that any building that can get by the supervising authorities is good enough to house a horse and wagon. This type is undesirable, for once a fire starts, it usually runs rampart throughout the entire building. The very nature of the contents being exceedingly combustible adds fury to the flimsy construction.

The best construction for this type would be heavy timber framing (instead of 2x4-inch posts), tin clad roofs, heavy plank or double floors, and all openings enclosed in planking equal to the floor construction with doors or traps made self-closing by means of fusible link attachments.

TERRA COTTA OR CONCRETE BLOCK.

The terra cotta or concrete block structure is little better than frame. Though it has a non-combustible roof, it is not much better.

ORDINARY CONSTRUCTION.

The ordinary constructed building is by far the most common type and is probably the best known. This type is usually three stories, sometimes four or five, with brick walls, plain glass windows in wood frames, open shafts, single floors, open or wood covered ceilings, composition roof, skylights of thin glass on wood frame and with wooden stalls.

To meet the standard, walls should be brick 12 inches thick at top floor, increasing 4 inches on each additional floor below and window opnings should be protected by wire glass in hollow metal frames, and where facing serious exposures, standard fire shutters should also be provided. Floor openings should be enclosed in at least 4 inches of fireproof material (i. e., terra cotta or concrete) with standard metal clad doors at openings. Small openings through floors may be protected with automatic traps of the same thickness as the floors. The floors should be double, preferably of heavy planking and the ceilings should be covered with metal or left open. Roof should be tin covered, skylights should be of thin plain glass set in metal frames with a staunch wire screen above to prevent burning embers from breaking the glass and falling into the building, and stalls should be constructed of non-combustible material. Where not above shafts, skylights may be one-half inch plain glass or wire glass on metal frames without screens.

MILL CONSTRUCTION.

This type of construction is usually found in connection with large factories in the outskirts and rarely in large cities. As a rule, they are a poor example of good mill construction and are not much better than the ordinary brick building. If constructed

standard, they approach in desirability the commonly found building of fire-resistive construction. The tremendous increase in the value of timber and labor, however, makes this type cost very nearly as much as a standard fire-resistive building.

STANDARDS FOR MILL CONSTRUCTION.

A one-story building without basement, even though of "Mill Type," would be considered as "Ordinary" by some rating bureaus.

Walls—Brick or reinforced concrete built in accordance with the requirements of the city building department having jurisdiction.

Roof—To be not less than 2-inch plank, splined and grooved on single stick roof timbers not less than 6 inches on the smallest dimension.

Floors—To be not less than 3-inch plank, splined and grooved with 1-inch tongued and grooved finish flooring on single stick beams not less than 8 inches on the smallest dimension. Bays to be not less than 4 foot on center of beams, nor more than 11 feet from center to center of beams. Floors to be inclined and scuppered to the outside of the building and to be made waterproof by placing between the two layers of flooring a single thickness of waterproof paper, same to be flashed 4 inches around posts and at sides, and joints of paper to overlap 6 inches and to be swabbed with tar. If ordinary building paper is used, two layers of paper should be used and the entire surface between the two layers be swabbed with tar.

Joists, Beams and Girders—Where entering walls to be made self-releasing.

Posts—To be not less than 8 inches by 8 inches on the highest floor and increasing 2 inches on a floor in descent. If metal columns, beams and girders are used, the same to be insulated with not less than 2 inches of approved insulating material.

Floor Openings—All floor opening shafts to be of standard construction and not less than 6 inches in thickness of hollow terra cotta or reinforced concrete or 8-inch brick and to be independent of floor construction. Openings to lofts to be protected in a standard manner. This includes stairways, elevators, vent shafts, power shafts, light wells, chutes, dumbwaiters, etc.

FIRE-RESISTIVE CONSTRUCTION.

The fire-resistive type, commonly called "fireproof," is the best obtainable and if built standard it is an ideal risk. The customary construction is reinforced concrete walls, floors and roof, or steel skeleton frame with concrete, brick or terra cotta curtain walls and similar floors and roof. Floors are often

surfaced with wood and shafts are open, or enclosed with wood or plaster block, and stalls are built of wood.

Note—Plaster block is little better than wood and its use should be discouraged. A hose stream played upon heated plaster block causes it to disintegrate in a very short time, and if used for shafts this would allow the fire to communicate from floor to floor.

The ideal risk should have all structural metal work protected with at least 2 inches of good fireproofing material (i.e., terra cotta or concrete), floors should be cement surfaced and inclined to the side walls, where scuppers should be provided to permit draining. Shafts throughout should be enclosed in at least 6 inches of good fireproofing material with openings protected by standard doors.* Very small openings, such as chutes or drops, may be protected with automatic trap doors constructed of one-quarter inch boiler iron riveted to stout angle iron frames. All exterior window openings should be wire glass in hollow metal frames. Stalls should be of non-combustible material, except floors may be heavy planks thoroughly caulked.

EXPOSURES.

Walls facing very serious exposure should be blank, others should have the openings protected as specified in the preceding paragraphs. Windows should be self-closing so that the minimum amount of smoke will enter and thereby avoid suffocating the horses.

COMMUNICATIONS.

When the area is very large, it is desirable to separate the building into sections, not exceeding 5,000 square feet, by standard fire walls. Openings between sections and into other buildings should be protected each side of wall by a standard fire door arranged to close automatically.

THE OCCUPANCY.

In giving this occupancy let us consider that we are inspecting a large private business stable and, for our purpose, this class will cover the general occupancy liable to all stables.

After sizing up the buiding from the street, taking note of its height, condition, and exposures, we will go up to the roof and work our way down to the basement, which is the general practice with all fire insurance inspectors. On the roof, the exposure may be verified. Note the kind of roof, roof structures, skylights and ventilators and whether the latter are on wood or metal frames. On the top or fifth floor may be found

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* All doors, windows, extinguishers, fire hose and shutters should bear the label of the Underwriters' Laboratories.

the storage of odds and ends. On this floor and each one below note the ceilings, examine walls for lath and plaster furring, thickness of floors, protection to floor openings and look for broken windows and plaster, also accumulation of rubbish. On the fourth floor will be found the harness repair room, tackle and rigging storage, blanket drying, carpenter's bench for repairs, and perhaps an enclosed room for painting. The third floor is used for the storage of hay and feed. Look particularly for hand-closed traps in the floor. The second floor is fitted with stalls for horses and on the first floor may be found storage of wagons and occasionally automobiles, while in the basement, we find additional stalls for horses, and elevator machinery, thus completing our inspection of the building.

HAZARDS.

Briefly the hazards to be noted by the inspector and those which should be brought to the attention of the underwriter are:

HORSES.

Aside from the property loss, horses present a mortuary hazard which is quite serious. In case of fire or even smoke, a horse will lose its head entirely and refuse to leave its stall. They seem to have a notion that you are taking them into danger, instead of removing them from it. This is why it is often necessary to place bags, blankets, etc., over their heads in order to lead them from their stalls. When not so covered, they have been known to return to the fire. Because of the great amount of trouble in bringing the animals to the outside, it is desirable to have the stalls on the street floor. However, in cities, they usually occupy the basement, second, and sometimes third or fourth floors. The further from the ground they are located, more serious is the hazard to life. Where stalls must be either above or below grade, the runways should lead direct to the street and not to the interior of building where they may be blocked at night by wagons. Even though the utmost care is

Usual type of stable construction.

taken, the loss of animal life is usually very severe in stable fires. About the only chance they have is where a number of persons can be called upon in a very few minutes to enter the building and rescue them.

A large packing concern in California has installed an automatic means for opening the doors of its horse stable which allows the horses to escape at any time of the day or night if there is danger of fire. The device is operated in much the same manner as an automatic sprinkler. When the temperature in the stable rises to a certain point, a weight is released which falls on a lever that in turn releases all the doors simultaneously. At the same time certain noises resembling "Git App" are made mechanically which frighten the horses from their places. The releasing lever is occasionally operated by hand to give the

This picture illustrates what may be expected if horses are kept above or below the grade floor.

horses a fire drill. Each horse soon learns to trot from its stall when the door opens and the alarm sounds.

CARRIAGES AND WAGONS.

The inspector should always report whether wagons or carriages are above or below the grade floor, and whether wheels of any have been removed. If they are all located on the grade floor, it will be easy to remove them in case of fire, but if they are either above or below the grade floor, the runways or exits should lead direct to the street instead of into the interior of buildings.

OPEN FLAME LIGHTS.

This is the most common hazard and is the one most feared by underwriters. Fires constantly occur by straw and hay coming in contact with the open gas flame when feeding horses or making up their bedding. It only takes a small amount of smoke from the hay to snuff out the lives of the horses. A fire starting in this manner gains such headway that it is ordinarily impossible to extinguish the flames without the aid of the fire department. The danger cannot be too greatly emphasized. On floors where horses and feed are kept, all gas brackets should be removed and the pipes capped and electric lights substituted. Where electricity cannot be obtained, a standard stable lantern should be permanently fixed to enclose each open gas jet. This lantern will prevent straw and hay coming in contact with the flame.

Usually any shack is considered good enough to shelter horses.

The common practice of carrying kerosene oil lanterns about at night is dangerous. If lanterns are needed, they should be of the locked type, burning lard or signal oil.

WOODWORKING.

The carpenter's or wagon builder's room should be kept free from shavings by placing them in metal cans and removing regularly. Should the work be extensive or if power machines are used the hazard involved should be great enough to place the risk in the carriage and wagon builders class. (See Live Articles on this subject.) It would be desirable to have this hazard in a fire resistive room with a standard fire door at the opening. Heating of glue is often done over an open flame. Glue should be in a water jacketed pot and heated by steam or electricity. Gas may be used if the pot and setting are as shown in the accompanying sketch.

PAINTING.

All paints must be kept and painting done in a separate fire-

This oat crusher is without magnets, but is approved because screens prevent foreign materials from contact with the rollers.

proof enclosure of not less than 6 inches of terra cotta or concrete with a standard fire door at the opening. Paints kept in the building should be reduced to a day's supply and a metal vented box or fireproof vault be provided outside of building for the surplus stock. Extreme care should be given to the disposition of paint rags, for which self-closing metal waste cans should be provided. (See Spontaneous Combustion.)

BLACKSMITH.

This feature will be found in very large stables where the number of horses on the premises warrant keeping a man for constant service of shoeing horses. Forges and anvils will often be found on wood floors and without metal hoods, the sparks flying indiscriminately about the floor. All forges should be brick set and heavy sheet metal should be placed on the floor under and at least four feet from all sides of both forge and anvil. Even a greater distance is desirable for when a blacksmith strikes a hot iron the red hot particles sometimes fly fifteen feet away. All combustible material should be kept a safe distance from the source of these sparks.

HEATING.

Floors occupied by horses are never heated. Occasionally there will be found on working floors small coal stoves set on unprotected floor and with smoke pipe resting against wood. A staunch metal shield should be placed under the stoves and extend 2 feet in front so as to catch falling hot ashes, and the smoke pipe should be kept at least 18 inches from combustible material. If heating is by steam or hot water, which is standard, the boiler should be set clear of all woodwork with smoke pipes 36 inches from combustible parts. Steam pipes should be 2 inches from woodwork and have metal collars with an inch of air space where passing through floors.

POWER.

Nearly all large stables have oat crushers which are used for crushing the oats, thereby making the grain more palatable for the horses. Foreign substances, such as nails, may strike the rollers of the crusher and cause a spark, resulting in an explosion or fire. To avoid this, magnets should be placed in the funnel or chute above the rollers to catch these particles.

Electric motors should set on metal drip pans to catch oil drips and self-closing metal waste cans should be provided for oily rags.

Gas engines are sometimes used for hoisting elevators and they should always set on metal to catch oil drips. Gas bag should be enclosed in an air tight metal drum vented to outer air. Exhaust chamber and pipe should be clear of all woodwork by 6 inches and extend to the outside of building. If the exhaust is through a chimney, the pipe should be continuous; exhausting in the chimney would loosen the bricks from the mortar, rendering the flue unsafe for future use. Many fires start from floor beams charred by use of unsafe flues.

Steam boilers for power should be set on brick or concrete foundations clear of all woodwork and smoke pipes should be 36 inches from combustible materials. Flues should be 8 inch brick with one inch tile lining and boiler room should be enclosed in 12 inches of brick with a standard fire door at the opening. It would be more desirable to have the boiler in an extension separated by a 12-inch brick wall with a standard fire door each side of wall at each opening.

HARNESS ROOM.

In this room will be found soiled, worn and broken harness and sometimes tackle and rigging. Look for Neatsfoot oil, which is used for softening harness leather. It should be kept in a metal can and the can placed on a drip pan. A self-closing metal waste can should be provided for rags soaked with this oil. (See Spontaneous Combustion.) Collar stuffing is often done in this room and the presence of loose straw or excelsior

makes this feature dangerous. A standard packing bin should be provided where any quantity of this material is kept. If the quantity is very small, a metal can with a tight fitting cover would be acceptable. Watch for prepared leather dressings containing benzine or similar quickly evaporating and highly explosive liquids. The amount in building should be limited to one quart in a safety can.

BLANKET DRYING.

Blankets and clothes are sometimes dried by hanging them on wood racks in small frame enclosures heated by coal stoves. The use of coal or gas stoves for this purpose is not permissible, because the blankets and clothing are apt to fall against the open flame. These rooms should be constructed of non-combustible material or at least lined with lock-jointed, blind-nailed metal and heated by steam. Care should be taken to keep steam pipes 2 inches from all woodwork. Metal racks should replace all wood racks.

UNTIDINESS.

Cobwebs should be removed from ceilings and floors kept neat and free from dirt and rubbish. Metal rubbish cans should be on each floor.

ROOF STRUCTURES.

Frame roof structures, bulk heads and ventilators are dangerous because fire brands from nearby buildings are apt to lodge on them, smoulder and finally break into flames. Rubbish should not be permitted to accumulate on roof or in roof structures. Such structures if indispensable should be of non-combustible material or at least metal covered. Bulkheads above elevators should be examined for oily waste also for paper placed on iron grid to catch oil drip from the operating machinery. Metal drip pans should be substituted.

AUTOMOBILES.

Frequently, automobiles are stored in stables. No hazard is presented if they are dead, that is entirely drained of gasoline, even to the carburetter and piping. If the tanks contain fuel, the hazard is severe and is increased where there is storage of fuel, filling, washing of parts with gasoline, smoking or open flames. (See Live Articles on Garages.)

SPONTANEOUS COMBUSTION.

In this class of occupancy, spontaneous combustion is apt to occur from straw or hay tightly packed in bales without ventilation and from manure left in wood chutes or piled against wood walls. Manure should be removed regularly and not allowed to accumuate. Rags soaked with Neatsfoot oil, paint rags and oily rags at motors often "burst" into flames, especially when mixed with rubbish in corners, or in confined places.

As a class, the protection against fire is poor. Fire pails are usually empty and rusted. Each floor needs one fire pail to every five hundred square feet of floor area and they should be covered to prevent evaporation. Bucket tanks containing six fire pails are neater and require less care and space. To prevent freezing, one and one-half pounds of common salt or calcium chloride should be dissolved in each gallon of water. Chemical extinguishers also afford good protection. Plenty of the one quart type extinguishers should be provided at motors, oil rooms, paint rooms and at automobiles.

A standpipe would give added protection and should be installed. Connection should be made to tank on the roof which reserves for fire lines at least 3,500 gallons of water to each 5,000 square feet of ground area. This could be arranged by placing the standpipe connection at the bottom of tank and the house supply pipe could take off above the reserve point. The bottom connection should be raised 6 inches to avoid sediment lodging in pipes and tank should be filled by a separate pipe emptying into top of the tank. One riser at least 6 inches in diameter should be provided for each 5,000 square feet of floor area and placed in stair shafts. The line should go direct to the basement and there extend to street where a siamese hose connection should be placed for fire department use. If building is on more than one street, a siamese connection should be provided for each and be cross connected with each other. Siamese should be constructed so that they will not rust and caps should be chained fast. Care should be taken that the flapper inside of siamese is arranged to cover up one opening when the other is in use. Check valves should be placed below each siamese inside of building and a drip valve provided at the lowest point between siamese and check valve to allow draining. A check valve is also needed just below the tank to prevent water pumped by the fire department from entering the tank through the standpipe. A gate valve with fifty feet of unlined linen hose is needed on each floor at each outlet and at the roof there is needed an outlet properly housed from the weather and provided with sufficient amount of rubber lined linen hose.

Automatic fire alarm service where by means of a thermostat an electrical connection is made in case of fire and an alarm sent direct to the fire department is an excellent thing.

A watchman should patrol the building hourly at night and during idle days, making records with a standard clock at fixed stations.

Undoubtedly, the automatic sprinkler is the highest form of protection devolved by experts in fire prevention and where possible this form of protection should be recommended and in-

stalled. Few if any stables are thus protected because the value in these buildings seldom is high enough to make it an attractive investment. However, from the standpoint of the saving of life and for conservation, it would show great returns.

CONCLUSION.

In conclusion, an ideal form for reporting stables would be roughly as follows:—

Location................ Assured.......... Property..........
Class of Stable.......................
Construction ....
Occupancy ....
Location of horses and wagons.....Exits (leading to ? blocked)
Hay, straw (Location, amount).... Oat Crusher (magnets)....
Manure Pit and Chute...........................
Blacksmith Shop.............Work Rooms (Painting and Repairing)
Heating ......Lighting ......Drying Blankets...... Power.....
Fire Protection....... Watchman...... Automatic Alarms.....
Special Features....... (Could horses be easily taken to street)
Place used as a hangout?..................
Smoking signs (displaced).............. Automobiles.........
Exposure (serious).................

GRAIN DUST HAZARD.

A Brief Treatise on Grain Dust Fires and Explosions, Pointing Out Their Causes and Possible Remedies.

By William J. Tallamy, Inspector.

The recent Brooklyn disaster which practically resulted in the total destruction of a row of nine large buildings and their contents, consisting of millions of dollars worth of grain, was probably due largely if not entirely to the presence of grain dust, a hazard so common in risks of this class that its grave dangers are frequently underestimated.

This disaster is typical of many similar calamities that have occurred during the past half century, except that in the de-

View from Columbia and Amity Streets looking north.

struction of the Dow Stores and Grain Elevators there was a providential absence of the loss of life that frequently accompanies such accidents.

Like nearly all similar disasters, the trouble appears to have started with an explosion of grain dust, which resulted in a fire lasting over a week, destroying everything in its path.

It is a fact well known to those familiar with the subject that grain dust and in fact the dust of any combustible material is

not only highly inflammable when mixed with air, but offers grave explosive possibilities. The dust of grain is even more dangerous than that of coal in this respect, as its point of ignition is lower while its explosive power is greater.

As far back as May, 1878, a grain explosion occurred in Minneapolis, which generated force sufficient to project heavy pieces of sheet iron two miles or more, flames from the ensuing fire extending several hundred feet high.

One reason for the ready inflammability of dust is the occlusion of atmospheric oxygen, or other gases or vapors, if any be present, by the minute particles of dust, which are more or less porous and have an absorbing tendency.

When grain dust is suspended in air, its highest degree of

View from Amity Street looking east. Note the partly destroyed large frame bins and the badly warped heavy steel structural members at the right.

superficial surface is exposed to the oxygen in the air and other gases or vapors that may be present, which it has a tendency to absorb.

Laden with this oxygen, gas, or vapor, these dust particles form highly inflammable material, which ignites with great rapidity, liberating hydro-carbon and carbon monoxide gases that form an explosive mixture with the remaining air which is ignited and exploded by the glow or flame of the burning dust. In other words, when a particle of grain dust suspended in air is heated sufficiently it becomes enveloped or surrounded by a cloak of inflammable gas or vapor many times larger than the particle itself. As the heat in the dust develops to the point of

glowing it ignites these inflammable gases, which burn with an expanding flash. If the air is filled with particles of such dust in sufficiently close proximity to each other, the rapidly successive generation and ignition of inflammable vapor or gas given off by them as the flame spreads gives rise to a condition similar in effect to that of burning hydro-carbon vapor.

Consequently, dust explosions occur in two stages: the ignition of the dust particles and the explosion of the resulting and ready formed gaseous products. These two phases follow in such rapid succession as to form practically one operation. If a rapidly burning mixture of this kind occurs in a confined space, an explosion will result, the violence of which being governed by the inflammability of the dust, the richness of the mixture and the nature of the confinement. The proportion of dust to air necessary to insure combustion is roughly estimated to be by volume one part dust to several thousand parts air. The puffy, explosive nature of grain dust fires promotes a condition most favorable to its spread, causing a diffusion of any dormant dust accumulations that may be present and an upheaval of the grain itself, releasing the highly inflammable husks, chaff, etc., mixed with it, all of which promptly ignites, burning like a roaring furnace.

The question naturally arises as to what is likely to cause the ignition of grain dust under normal working conditions. It has been established through experiment that grain dust will ignite when exposed to very low temperatures. As clean, dry grain dust is not subject to spontaneous ignition, sufficient heat to ignite the dust must come from an outside source, such as an open light or flame, electric spark due to broken lamp, short circuit, defective wiring or insulation, frictional spark or spark resulting from static electricity. It is probable that the latter is the more likely cause-in modernly equipped plants.

It is possible, however, to reduce the hazard of grain dust to a minimum. With this end in view the writer suggests the following:

Structurally—Let each building be so constructed as to be a positive one-fire risk, detached if possible, with walls sufficiently heavy to withstand any possible interior pressure they would be likely to be subjected to, either by force of explosion or pressure induced by swelling of the grain therein as result of being wet down in case of fire. No communication with other buildings should be permitted.

The structure should be well ventilated and provided with sufficient blower equipment to keep the interior reasonably free from dust.

No dust accumulations should be allowed to collect on beams, girders, ledges, shelves, floors or any exposed surfaces.

If practicable the air in the interior should be humidified,

either by the use of a steam jet or properly located water spray, as the dust, being more or less porous, absorbs the moisture and settles more quickly.

All open lights or flames should be prohibited.

Well insulated electric wiring should be installed in metal conduits (naked insulated wiring has been known to give off electric sparks when charged with electricity in a cloud of dust).

All switches, fuses and starting boxes, motors and any electric fixtures or apparatus should be installed in a place absolutely free from dust, preferably outside of main building.

All electric lights should be provided with approved dust and moisture-proof sockets, double globes and enclosed by wire guards to prevent breaking.

All movable machinery, pulleys, shafting belts, elevators and other equipment by which static electricity could be produced should be properly grounded. A good method of grounding this equipment would be to connect all said working parts with one common wire and grounding that wire.

THEATERS AND FIRE SAFETY.*

Construction of Theaters with a View to Safeguarding Human Lives as Well as Property Against Loss by Fire.

By C. H. Blackall, Architect.

Building laws seldom remain up to date for many years. What is considered absolutely essential for one generation may be in part ignored by a succeeding one and new and untried methods are constantly presenting themselves in advance of legal authorization, so that the laws always lag behind the most advanced practice and a moss-grown precedent is very hard to abolish. It can almost be said that every great progress which has been made in our building construction and equipment during the last forty years has taken shape in practical defiance of existing laws. I need only refer to such innovations as reinforced concrete, skeleton construction or artificial stone to recall to you how some of these factors were absolutely prohibited by law for many years, and the more I study into the matter of building regulations, the more respect I have for a law which does not undertake to specify every detail, but can be so drawn as to give the minimum of protection with the maximum of elasticity and which will require the minmum of expense. There are few laws such as this. Laws are made theoretically for every one; practically they are to guard against ignorance and deceit. If building construction and equipment were always to be in the hands of educated, conscientious builders, engineers and architects the world would be a great deal better off if every one of our building laws were thrown into discard and the only requirements left were that construction should be safe.

Of course such a procedure would be impossible, for right at the outset we would be confronted with the necessity of defining safety, and in no one class of buildings is this definition more difficult of application than in theaters and halls of audience. The problem is much more manifest by reason of the fact that it is a comparatively modern one. Of course we have had theaters since the year one, but in American practice we only began to build theaters about twenty years ago. Before that time in our largest cities there was scarcely one theater to 60,000 inhabitants. At present in many cases the proportion runs as high as one theater to every 3,000 or 4,000. A generation ago

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the theater-going population was less than 10 per cent. of the population. At the present day in the city of Boston alone six performances with every seat occupied in every theater would require an aggregate attendance equal to the entire population of the city. These figures are, of course, only approximate, but they illustrate the tremendous extension of theater construction and with that extension there have been developed a great many laws, most of them excellent as determining the maximum standards, but also most of them containing inadequate provisions and many absurd and obsolete requirements. Somehow the theaters have seemed to be an easy mark for all our legislative committees and the requirements have been piled on and accumulated notwithstanding protests and notwithstanding the fact that accidents, fires and damages in theaters are surprisingly few in number and almost negligible when we include only those that occur while the audience is in the house.

Our laws are not the result of any lack of present available expert knowledge. There are architects who are designing theaters to-day not by the dozen, but by the hundred and there is no difficulty in epitomizing the real necessities of the problem. I will not undertake to go into the whole subject of theater laws for you, though it is by no means a long task, but I will call to your attention briefly some of the more debatable provisions which are made for the safety of life in theaters and the safeguarding against fires and then will ask you to consider wherein these laws might be materially modified with a great reduction in cost and no loss in actual safety.

The mere matter of construction need not detain us. The construction of a fireproof theater is no different from that of a fireproof building of any sort and the science has been elaborated as applied to all classes, so that there is nothing about the construction of a theater as such that makes it different from that of any other large building. I will assume that there is no real difference of opinion as to the desirability of most of the factors which enter into theater construction, such as sprinkler equipment, automatic fire alarms, standpipes, etc., or the arrangement of seats, aisles, foyers, dressing-rooms, heating and power plants, etc. There is, however, one vital respect in which a theater is different from any other fireproof building, and regarding which there is need for considerable most careful study, and that is in the exits. This constitutes the real crux of the problem of safety, the one about which the greatest difference of opinion exists and regarding which there is opportunity for the greatest variety of treatment.

Let us admit at the very beginning that there is no such thing as an absolutely safe assembling place for a crowd of human beings. Many years ago there was a popular meeting on Boston Common attended by many thousand spectators. In the midst

of the exercises one of those inexplicable panics struck the crowd with a spasm of fear which lasted but for a few moments, but during which the lives of a score or more human beings were trampled out. We cannot make any system of stairs or exits either fool-proof or panic-proof. The most we can hope to do is to require such provision as will allow an orderly crowd to gain exit to the street. I know of no theater fire in the world's history accompanied by loss of life where it was not possible for the firemen to enter the auditorium immediately after the last spectator had fled. It is a fact that most of our theaters would be perfectly safe as far as exits are concerned if there were no panic and that none would be absolutely safe against any panic. I claim then that there is one fundamental principle to be observed in planning the exits of a theater and that is there must be no such thing as emergency exits, no such thing as fire escapes and no such thing as unused stairs, but that all the stairs must be used for exits at all times and must be known a such. Better only two exits used all the time than a dozen exits of which only two are in common use, The idea that a crowd in a panic will open a self-closing door to gain access to an unknown stairway even when it is marked fire escape does not sound like good logic and is not borne out by the few observed facts which are within our reason. The public will generally leave the theater by the way it came in. In a practice including several hundred theaters I have yet to find one single case in which the so-called fire escapes or emergency stairs have ever been used at all. They are put in as required by law in every case. They represent wasted money, wasted space and a menace, because the law in nearly every case recognizes them as constituting a part of the total exit capacity required and the auditors are deprived of just that much chance of escape in time of danger simply because they do not know of them and have not been used to finding them. One of the first theaters I erected in Boston has a most ingeniously elaborated system of outside balconies and balanced ladders, which I tested personally and know how they worked, which have been there now for twenty years and so far as I know not even the manager has ever set foot on them. If I had not for my own curiosity tried them within a year I would not be even sure that the balanced ladders would work at all.

So then the first provision for safety is that we shall make our exits and our entrances identical and use both of them all the time.

The building laws in nearly every large city in this country provide that there shall be on each side of the auditorium an open space or court to be used for emergency exits. Some cities allow this space to be closed up pretty effectually at different levels by iron balconies, some are more logical and require

the stairs from these balconies to be outside of the courts, and in a very few instances these courts are left unobstructed. I have been instrumental in having provision for these side courts incorporated in several building laws. I put in the provision deliberately, believing that these courts had a real value and that they were essential to safety in every theater; that in fact the requirement was fundamental and could not be denied. But an experience covering several hundred theaters has convinced me that this provision is wrong, that it does not make for safety, but for danger, and that open courts as such should not be permitted in any case. I do not refer to open spaces 10 feet or more wide and certainly not to cases where the theater is on side streets so that the whole side of the theater is exposed, but the theory that a long, narrow court, open to the sky and subject to all the exposure hazards of the neighboring structures is likely ever to afford safe egress in time of fire or panic is in my judgment entirely fallacious.

Let us consider for a moment the alleged principle of these courts. When the idea was first brought out some twelve years or more ago it was considered that the advantage of the court would be partly in giving facility for firemen to introduce lines of hose and fight a fire in a theater. It is hardly conceivable, however, that if the interior of a theater were ablaze firemen would be so foolish as to try and fight it from the average theater court, but would surely bring their hose in either from the use of the grille type of fire escape, and quite aside from the stage end of the theater abutting on a rear street. In fact, the place from which to fight a fire in any theater is the rear. Theater fires do not start in the front of the house, but almost invariably somewhere around the stage, and if it were only a question of fighting the fire, the courts would absolutely be of no value, as the firemen could much better work from the rear of the stage.

The second supposed purpose of these courts was to accommodate lines of exterior iron balconies and stairways constituting emergency exits. The experience of fires everywhere is against the use of grille type of fire escape, and quite aside from the question of the inadvisability of such things as emergency fire escapes, the particular form which has become associated with the side courts is dead wrong and as a matter of safety should be absolutely prohibited. Some cities have tried to forbid them and several are continuing the fight in this direction, especially since the Binghamton fire, where helpless girls were roasted to death on these grille fire escapes. So that each of the two purposes for which the court was supposed to be adopted are undesirable and should not be considered in a safe theater.

If it be argued that the courts afford an immediate exit to the open air from each division of the auditorium, I would repeat

that any exits to such courts are more dangerous to life than if the exits were continued directly to a public street and protected the whole distance. The greatest danger to a theater is from a fire starting from without, causing a panic among the spectators or blocking the exits. Now, a side court, if opposite a building in flames, is the most dangerous kind of exposure, and the court would constitute a menace, especially as the laws of nearly all our cities not merely provide for but require exit doors, if not exit windows, opening onto these courts. No doors or windows should be allowed upon the side of a theater into any open court or on any party line, or within 20 feet of any other building.

Most of the building laws prescribe a minimum aggregate width of exits and the amount of such exit space required varies from 20 to 40 inches for each one hundred people. Exact information on this subject is lacking, but as a result of observations on many theaters counting the passage of people, I cannot agree that a greater measure than 30 inches for each hundred people is necessary for exit space if the exits are properly arranged, the runs of stairs short, and above all, if differences in level are overcome by gradients rather than by stairs, and especially if every exit is enclosed in its whole length, leads directly to a public street and does not share its width with any other means of exit. But even 30 inches, or any arbitrary limit, is unscientific. I well remember my first experience in writing a theater law. I very carefully assumed a certain form of law and a certain relative arrangement of stage, proscenium and exits and I wrote out the provisions of the law on those assumptions. Under that law I have since constructed forty or fifty theaters, not one of which met the conditions which I assumed, so that while it is wise to establish a minimum aggregate width, which I should put at 30 inches for 100 people, a wise consideration for safety would insist upon this as a minimum and would greatly increase it under some conditions.

There are still other points in which practical experience does not endorse existing building laws. Most of our building laws require a lobby to precede each division of the house, and the New York law calls for an open space in the auditorium to extend 15 feet behind the last rows of seats. Both of these are needless requirements as far as safety is concerned, for it is not conceivable that an audience in the case of a panic would meekly walk out into lobbies and stay there for a while to think about it before going outdoors. Lobbies have their practical and decorative purpose, but if we consider safety as the prime requirement, the quicker we can get the audience out into the street, the better, and the fewer the halting places on the way, the quicker the exit will be accomplished. The open space behind the parquet seats as required by the New York law is abso-

lutely wasted, does no one any good and does not contribute in the slightest degree to safety.

Years ago, when all theaters were constructed with wood floors and fireproof construction was unknown, some brilliant mind conceived the idea of cutting off the auditorium from the stage by a brick fire wall, and it is a comparatively few years only since some of the building laws required the curtain opening in this proscenium wall to be spanned by a girder of proper size to carry the load and the girder in turn spanned by a relieving arch of brickwork. Nearly every proposed model theater law has placed much insistence on a brick proscenium wall, as if it were of fundamental importance, whereas for a matter of fact a properly constructed steel frame filled in with terra cotta and plastered both sides is lighter, saves space and money, and answers every real need of safety. Fire never would spread from the stage even through a 1½-inch plaster and metal lath partition while the curtain opening is there, and a brick proscenium wall is a relic of the days when fireproof construction was unborn. Boston is one of the cities which does not require a brick proscenium wall and there is certainly no justification for it in any city. Fireproof construction, while misnamed, is certainly fire resistive to a high degree, and has become too much of a science and too positive in its protection to call for the extravagance and unnecessary waste of brick construction. And while the curtain opening is admittedly the weakest factor in the whole structure, there is no particular value in the elaborate, solid curtain which some cities insist upon for the proscenium opening. What we fear is not fire so much as smoke, and a great deal less expensive construction will keep out the smoke plenty enough to permit of reasonably safe exit for the people. The solid curtain, if easy of operation, and if it could be depended upon to operate quickly, would, of course, be a more absolute stop, but it is so clumsy and so likely to get out of order or to be neglected in a critical emergency that I far prefer a properly constructed and installed asbestos curtain woven on a copper warp and running in slots on the sides.

To sum up, therefore, my personal objections to the existing requirements for theaters, speaking wholly from the standpoint of safety, I believe that—

(1) The open courts are unnecessary and often dangerous.

(2) The exterior grille type of fire escape is thoroughly bad and should not be tolerated.

(3) Emergency exits as such should never be allowed.

(4) An aggregate width of exits is quite as much a matter of arrangement as of feet and inches.

(5) Lobbies and standing-up space behind the seats are of

doubtful value unless they are a very direct communication to an outdoor exit.

(6) A brick proscenium wall is a needless anomaly.

After having voiced my objections to existing building laws I was recently called upon to meet such objections by a new building law for the city of Cambridge and for one of the large cities on the Pacific Coast. I have a brief draft of the law which was so prepared covering the points I have raised, which I shall be glad to explain to any one interested. I will not take your time by going through it, but will say that the essential points are as follows:

There are to be no windows or openings of any sort toward adjoining buildings from the auditorium. The use of courts is left optional, but all exits are to lead directly to streets, either front, back or sides, covered throughout the whole extent of the theater property, so that fires from adjoining buildings will have no effect and a panic or disturbance in one set of exits would not be communicated to another. There would be at least four means of egress from each division of the house, no such egress to be less than 5 feet wide, except some minor communications, such as to boxes, etc., and one exit is to be in each of the four corners of the auditorium. The exits of first story and balcony, or balcony and gallery, may combine into a single exit, but not more than two exits are to be brought together. The aggregate width of exits for the two corners furthest removed from the proscenium is to be estimated on the basis of 20 inches for each 100 people in the portion of house served. The aggregate width of the exits for the corners nearest the proscenium is to be estimated at 10 inches for 100 people. No exits are to be marked as emergency or fire escapes, but all are to be open and used during every performance. No exits less than 5 feet wide are to be counted. This means that each division of the house would have four distinct means of egress directly to the street.

I may say further that I have actually worked out the application of this law and find that in nearly every case, though the aggregate of exits would be more than are required in Boston to-day by the laws, the seating capacity of the house would be larger and the expense would be less. In other words, the first cost would be reduced and the earning capacity and safety greatly increased. This is due to the fact that though our laws theoretically call for total exit capacity of from 30 to 40 inches per 100 people, the so-called emergency exits are counted in as part of the regular exits and simply deliver into the side courts. I have seen cases where exits from the auditorium aggregating altogether 30 feet in width have all converged into a single 6-foot court.

The first requisite of a theater is not safety, but to make money. Whether we admit it or not, that is the fact, but there is no reason why the maximum earning capacity should be incompatible with the maximum safety, provided considerations of safety are viewed from a sensible, practical standpoint and in the light of experience and recognition of existing conditons rather than evolved from any abstract theory of fire protection. The actual danger from either fire or loss of life is extremely small. I have never been in a theater fire and have never seen one in operation and am quite ready to admit my views may be quite as wrong as the views I have criticised. I can only say that while my views are in opposition to nearly all of the existing laws, they are based entirely upon experience and not at all upon theory.

CARELESS USE OF MATCHES.

The Annual Toll of Carelessness with a Common and Useful Article.

By S. T. Skirrow.

Time was when matches were a luxury. Now they are a necessity and are so cheap and common as to be thrown about in many careless ways.

Incomplete reports of the National Board of Fire Underwriters for the year 1915 show a loss over the country totaling $4,324,596 due to matches.

In New York City alone the fire department's report of 1915 shows that there were 1,346 fires attributed to matches, causing a loss of $227,886.

The National Fire Protection Association has done much to educate the public and bring to the attention of law makers the hazards presented to life and property by the improper manufacture, sale and use of matches. This association has sent its secretary on lecture tours throughout the country on numerous occasions and has prepared, published and distributed broadcast pamphlets containing suggested State laws and city ordinances.

In this connection, they claim to be the pioneers of the change from the old-style "snap-stick" sulphur match to the approved safety match.

In brief, the suggested ordinance for cities makes its unlawful to sell or distribute parlor, blazer and wind matches; also double dipped matches, unless the outer bulb is inert and will survive an oven test of eight hours at 200 degrees Fahrenheit. Not more than one case should remain open at a time nor should loose or paper wrapped matches be stored at exceeding five feet from the floor; if in cases, not more than ten feet from the floor. They should be stored ten feet from any fire and twenty-five feet from explosive materials.

The suggested State law covers all that is mentioned under the ordinances, and in addition prohibits the storage or manufacture of the so-called parlor matches. Not more than 700 matches should be packed in one box, and when there are more than 350 in a box, one-half of the number should have the heads opposite. The limit for weight of cases is 75 pounds, unless lock cornered, in which event they may weigh 85 pounds.

The Underwriters Laboratories of Chicago have made a care-

ful study and test of matches and now issue the label service covering this line of goods. The testing covers the subject of flying heads, ignition temperatures, stability of head and composition, afterglow, strength of splint and method of packing.

The label service is divided into two classes. "Class "A" is the "strike on the box" type, where the match is struck on a prepared surface and the ignition point is above 340 degrees and the ignition point is above 300 degrees Fahrenheit. This type of match is double-dipped, the outside bulb being inert and of larger diameter than the tip. It is constructed so that it will not ignite from friction or when it is trod upon. The splints of both types of matches are treated to prevent afterglow and they are required to be of a reasonable strength.

At this writing there is only one manufacturer who has obtained the label service. This concern manufactures both classes of approved matches.

The hazard from the careless handling of matches cannot be too greatly emphasized and it would be well to advocate stringent laws for those who continue to use them with utter disregard for the loss of life and property that they may cause.

TESTS OF BUILDING COLUMNS.

Results of a Joint Test of Materials Conducted by Two Large Organizations.

Fire tests of building columns, being jointly conducted by the Associated Factory Mutual Fire Insurance Companies, the National Board of Fire Underwriters, and the Federal Bureau of Standards, at Underwriters' Laboratories, are progressing according to schedule, two columns being tested each week. The work of testing began last summer and will require a year for the completion of the full series of 100 tests. This was preceded by several years' work in designing and erecting the testing apparatus and in preparing and covering the test specimens by the different methods and with the various materials required for a full investigation.

The apparatus used in the tests consists briefly of a gas furnace capable of being controlled according to a specified standard temperature curve, reaching a maximum of 2300 degrees Fahr. (1260 degrees Cent.), at the end of an eight-hour test. The load on the columns while being subjected to fire test is supplied by means of a hydraulic ram, an average load of 100,000 pounds being maintained during the test, this being calculated for the various sections according to accepted formulas for working load.

The temperature of the column furnace is measured by means of platinum and base metal thermo-couples, supported in porcelain tubes at two elevations; and that of the columns, by means of base metal thermo-couples attached to the metal of the column at four elevations and at different points in the section. The temperature indications are read with a potentiometer indicator and connections are also made to an automatic potentiometer recorder, so that graphic records can be obtained, if desired, of the indications of any set of couples.

The tests are continued to a break-down of the sample, and hence no inferences as to the comparative merits of the various column designs and column coverings should be drawn from the illustrations, which show simply the effect of load and fire on a number of samples which have been subjected to test. The time required to obtain failure varies with the type of material and thickness of covering, the periods for the columns so far tested ranging from 17 minutes for the unprotected column to over eight hours for the heavier types of protection.

AUTOMOBILE INSURANCE.

Development of Broad and Valuable Coverage Described in an Address Before the Providence Engineering Society.

By A. T. Vigneron, President Automobile Mutual Ins. Co. of America.

Automobile insurance must be considered a product of the twentieth century, although some coverages had been recorded in the London Lloyds previous to that time. The first policies were for fire only, but other coverages soon followed, to keep pace with the demand, and these now include theft, liability, property damage, collision, loss of use, and other minor risks. When automobile fire and theft policies were first written a premium rate of 2½ per cent. was charged. This was found to be unfair, and later a schedule rating based on valuations was adopted by all insurance companies. This schedule is figured on the ratio that the amount of insurance carried bears to the list price of the automobile. As an example, using the mutual schedule, a car listed at $4,000 and insured for that amount, would be charged a cash premium of $80, or 2 per cent. The same car insured for $2,000 would be charged a cash premium of $55, or 2¾ per cent. The increase in premium on the lower valuation is principally on account of repairs and replacements in case of partial loss, in which case the claim on the lower valued car would be as great as on the higher valued one for which a larger cash premium was charged. Then again, the cost of adjustment and expense for recovery in case the car was stolen as well as the overhead charges would be the same in both classes and consequently would warrant a higher percentage of premium on the lower valuation. The gasolene automobile is considered a much greater risk than most other forms of property by reason of the fact that it uses a highly inflammable form of fuel and contains within a small space considerable valuable machinery. It is here where the automobile engineer's assistance is called to account for the many improvements and betterments that have resulted in making the motor car less hazardous than in its earlier days. The garage risk has also to be considered by the underwriter, but the construction and regulations that have been imposed upon the modern garage has had a marked effect in reducing the loss of automobiles by fire.

THE MORAL RISK.

The paint-shop is now the chief hazard from exterior causes

and especially so during the spring of the year, when many cars are being painted or overhauled. Another hazard which must not be overlooked, and which by some is considered the greatest, is what is termed the moral risk or responsibility of the person owning or operating the car. When the first policies on automobile coverage were issued, there were three distinct types of power—steam, electric and gasolene. As the steam machine is practically now extinct, this paper will pass over that form of power as a risk and take up the two remaining types, which will perhaps always find a place for their utility. In the electric vehicle there are but two possible sources of risk, namely, the electric spark and over-heated wires. Sparks may occur at the controller, at the motor, or from cross wires or short circuits. All of the defects, however, have been largely remedied by proper insulation and arrangement of wires and machinery, so that the modern electric motor has become one of the safest power producing plants that the automobile now has. With the gasolene machine, however, the risk is more involved. First, because the power plant itself contains greater elements of danger, and, second, because the presence of considerable quantities of gasolene and oil increases the liability of a fire spreading, regardless of its origin. Considered in order, the elements of direct risk are: (1) fuel tank; (2) fuel piping; (3) carbureter; (4) electrical system; (5) exhaust piping and muffler, and (6) general arrangement. Any one of these elements may become a direct hazard as a result of poor construction, careless handling and accident.

LEAKAGE CHIEF DANGER.

The chief danger in connection with the gasolene tank and piping is leakage, since this is the principal cause of trouble where fuel tankage and piping are involved in a fire. As a means of preventing leaks, tanks have been so strengthened and mounted as to withstand the strain of the working of the car, while the piping has been so arranged that it will yield to frame distortion without injury to the couplings. The air inlet of the carbureter has been improved by providing a metal tube extending to stove around exhaust manifold, which prevents the flame of back-fire from flashing directly into the pan. There has also been provided a special drip outside the pan to take care of any leakage of gasolene. The electrical system has been entirely remodeled, first, by waterproofing distributor covers; second, by better insulation of wires and use of steel conduits for mechanical protection, thus reducing the possibility of grounds; third, by the carrying of high tension wires in fibre tubes; fourth, by completely housing in the generator and motor; fifth, by the elimination of vibrating contacts on coils, and sixth, by carrying the batteries under floor boards in open position instead of in back seat with tools. All of these improvements have greatly reduced

the number of fires from electrical sources, although carelessness on the part of the owner in allowing the wires to become loose or damaged still constitutes an element of risk.

Another danger, which has been eliminated, is the substituting of electric lamps for that of kerosene and gas. Numerous fires have been recorded as originating from the latter sources. Claim from lightning stroke is considered by some to be so rare as to make this coverage almost negligible, but the form used by some companies covering actual loss has proven in two instances at least to work out in the interest of the assured. In both of these cases the assured took refuge underneath a tree during a thunder storm. The tree being struck and falling upon the automobile, demolished the top and caused other damage which was considered a valid claim against the company. An automobile equipped as it is, with rubber tires, is almost immune from lightning stroke when in the open, but a tree is not the safest place for shelter.

FILLING THE TANK.

The filling of the gasolene tank is another element of danger, particularly when the tank is placed beneath the front seat. We have been called upon to pay several claims as a result of filling of the tank, two in particular on the same machine within a comparatively short time. The first report gave the cause as unknown, as the engine was not running and the owner was present when the filling was being done and vouched that neither his chauffeur or himself were smoking at the time the filling was going on. The second loss on the same car was reported also as cause unknown, and our adjuster was told that the assured, owing to his previous experience, was filling the car outside the garage when the explosion occurred. The chauffeur was in terror every time he filled the tank, always wondering what kind of hoodoo was inside. Here was a problem for us to solve and we finally called in the assistance of an electrical engineer, who went over the entire situation with our adjuster. In examining the opening of the tank it was observed that a hole was cut in the wooden support of the seat just above the opening in the tank. It was also learned that the neck of the funnel was usually placed through this hole, resting on the edge for support. This left a small free space around the neck of the funnel where it entered the tank. Now, in filling, chamois was used in filtering, and as the gasolene went through, static electricity was generated; and when enough had accumulated, it would ground by jumping across the space between the neck of the funnel and the tank. It was therefore concluded that this spark so generated caused both of the explosions; and the assured was told to rest the funnel on the metal tank when filling. As we have had no further claims since, it is quite evident that our conclusion as to the cause of both of these explosions was correct.

THEFT HAZARD GREAT.

While the fire hazard has been materially diminished in the past ten years, the theft risk has correspondingly increased. Little can be said concerning the theft hazard previous to the year 1908, for before that time few thefts were recorded and therefore no data obtainable that would assist the underwriter in arranging his form or arriving at an actual cost. This coverage is now acknowledged to be more hazardous than that of fire, and the facilities for coping with it are far less efficient, owing to the boldness with which the acts are perpetrated and the indifference in many instances on the part of the police and courts to apprehend and punish the offenders.

The usual form of coverage embraces two risks: first, the theft of the car itself carrying liability for the face of the policy in case the car is not recovered, or in case of recovery, any damage it might have sustained while in the hands of the thief, and, second, the loss of equipment necessary in the operation of the car as a result of pilferage. Then there is what is called a real theft and a joy ride. The first is when the intention of the culprit is to appropriate the car and dispose of it to his own advantage and the latter is when the intention is simply to drive the car for a period of time and leave it somewhere after its use is no longer desired. Both are criminal acts for which the insurance company is liable, but in many cases have to be treated differently.

In handling a real theft a well-organized corps of inspectors is necessary, the usual method of procedure being as follows: Upon receipt of notice of the theft of an automobile a telegram giving description of the car is sent to the inspectors nearest the place where the theft occurred. The surrounding country police are in turn notified by them first by telephone or telegraph, and if results do not immediately follow, by the mailing of postal cards offering rewards to garages, repair shops and supply houses. The manufacturer of the car is also notified with a request to forward notice of the theft and description of the machine to his agents.

Through this latter method a car stolen in Worcester was located in Lorraine, Ohio. In this instance, we notified our inspectors in Boston, Hartford, New York City, Montreal and Albany, and soon learned that a car answering the description had stopped at Springfield for gasolene. Knowing that the car was headed westward, we also notified Buffalo, Cleveland, Detroit and Chicago without response. The car was gone for more than two weeks, and when we had almost despaired of its recovery we received a telegram stating that the machine we were looking for had been recovered at Lorraine, Ohio, and in the following manner: A certain individual had entered the service station of the manufacturer of the car to purchase gasolene and

lubricating oil. The general appearance of the person rather excited the suspicion of the attendant, and, after raising the hood to replenish the lubricating oil, he glanced at the engine number of the car, and upon returning to the office noted that the number corresponded exactly with the one on the postal they had on file from the insurance company. He then requested another employee to notify the police, and, in order not to arouse any suspicion on the part of his customer, went about filling the gasolene tank. A few minutes later the police arrived, and all hands pounced upon the culprit and he was then escorted to the police station and locked up. The Worcester police, upon being notified, sent one of their inspectors with the necessary papers to bring back both the thief and the automobile. The car was shipped directly to Hartford for repairs, and the thief was taken before the courts, and after several appeals, usual in such cases, was eventually sentenced to six years in the Massachusetts penitentiary.

PILFERAGE LOSSES.

Pilferage is done mostly by the sneak thief or light-fingered fraternity, although we have encountered several cases where a business was made of stealing tires. In the latter case, the tires were stolen usually from visitors leaving their machines standing in front of houses in uptown districts. They would be removed from the car by the thief and carried into the yard of an adjoining house and left there. The owner, in most cases, would not discover his loss until the following morning; but in case he should make the discovery, the yard would be the last place he would be inclined to look for the missing tires. The thief would come later in an automobile and take his booty from the yard. It was some time before we discovered this mode of procedure and only by chance when a servant entering the house noticed the tires in the yard.

The earlier policies covered appurtenances without specific limitations and this was considered by many to cover articles never intended when the insurance was written. Claims ranging from Buffalo robes to diamond jewelry were presented until it became necessary to exclude robes, wearing apparel and personal effects in the coverage. One claim in particular was presented, including among other articles a dress suit case containing ladies' evening clothes and diamond jewelry valued at $600. Our adjuster attempted to explain that we only covered such articles as were necessary in the operation of the car. Whereupon the assured argued that the diamonds were necessary for operating the car, inasmuch as his ready money had been all used up for repairs. * * *

PUBLIC LIABILITY.

From the time motor cars took the place of other vehicles,

insurance companies have issued policies to protect owners of automobiles against claims arising from personal injuries and claims from damages to others' property. In some States where it is permissible protection is also granted to cover damages received by the owner's car. The protection generally called public liability is usually limited to an amount of $5,000 for injuries caused to any one person and $10,000 for injuries caused to two or more people in any one accident; but these limits may be increased at a slight additional premium. The usual limit of liability for damage to others' property is $1,000. By carrying public liability together with the endorsement covering against damage to others' property, the owner is protected against all suits that might be brought against him from accidents arising out of the operation of his car.

What we term collision insurance is the protection granted to reimburse the owner of a car for damages sustained, and is usually limited to the cost of replacement of the damaged parts of the car.

The cost of insurance against claims arising from personal injuries, or what is termed by the trade public liability, is based upon the horsepower of the car. Statistics have proven that the greater the horsepower, the greater is the chance for accidents, especially so with motors capable of high speed. During the first few years when policies were issued covering against these various forms of liabilities, the rates were necessarily high, owing to the uncertainty existing among the companies as to the actual cost of granting this coverage. Through their experiences, however, in the following years they have been able to gauge the expense ratio and as a result in many instances have greatly modified the cost of this insurance. To-day the loss ratio is applied to each State and subdivided into the various counties thereof according to the congestion of traffic.

Owing to the diversity of opinion, the cause of an accident is seldom viewed by individuals in the same light, and as a result of this, even though an operator may be blameless for an accident, witnesses are often of the contrary opinion. Invariably, insurance companies to avoid litigation are anxious to compromise with the plaintiff and pay an nominal sum for his signature on a release.

To-day, it behooves all owners of motor cars to exercise due caution in their care and operation, and to carry insurance in order that they may be relieved of the burden of worry which is part of the inheritance of the owner of an automobile.

MARINE INSURANCE.

Historical Sketch of Marine Insurance—How It Differs from Fire Insurance—Definition of Terms.

By Sir Douglas Owen.

Now, if you were asked, what should you say was the most essential point of difference between fire insurance and marine insurance? It might occur to you that the one is an insurance of fixed property on land, the other an insurance of moving property at sea. Such a distinction is, however, no longer what it once was. Fire insurance, no doubt, is constancy itself, and at any rate it will not insure property which is at sea. Marine insurance has one foot at sea and one on shore. It insures tea and tobacco before they are plucked and until loaded, as well as on their homeward voyage across the seas. It insures wool from the time it is sheared, while it is being baled, while it is in transit, and after landing, until it gets to Bradford. The whole journey by land and sea and a bit more is covered—and fire is, of course, one of the risks included. And for the risk at the docks at each end of the journey, and in transit sheds, the marine insurance policy gives protection against fire and other risks. The marine underwriter, whether at Lloyd's or at the companies, is a poacher born and bred; if under the plea of transit risks he can manage to cast his net over a bit of the fire insurance companies' business, he does so, gladly. And so you will sometimes find, when dock warehouses or transit sheds are burned down, that the goods, while under the protection of a fire insurance "floater," are also under a policy of marine insurance. They are, in fact, doubly insured, and each set of underwriters should in such circumstances pay half the loss. But the fire insurance companies, by whom marine insurance poaching is regarded much as the devil is popularly supposed to view holy water, have invented an artless little clause which leaves the poachers to pay the lot. You will remember the so-called "Marine Clause," under which the fire company disclaims liability for—

(g) Loss or damage to property, which at the time of the happening of such loss or damage is insured by, or would, but for the existence of this policy, be insured by any marine policy or policies, except in respect of any excess beyond the amount which would have been payable under the marine policy or policies had this insurance not been effected.

But what, then, *is* the essential point of difference between the fire policy and the marine policy? I should say it was this: That whereas, under a fire insurance policy, no one is entitled to claim more than the actual amount of his loss (I have heard the ungrateful say that he is one of fortune's favorites if he gets anything like as much) the actual value, in a marine insurance, is practically beside the question. Take the case of a shipment of wool or cotton—or tea or tobacco, if you like. The sanguine shipper believes or supposes that the market is likely to go up and that, though the value of the goods on shipment may be £500, when they get to market they will be worth £700 or £800, and for that sum he insures. The market does not go up; it may even go down. The ship goes ashore and breaks up just outside her destination, and though it is indisputable that if the goods had arrived they would only have fetched £500, perhaps not so much, the shipper is entitled to receive the full £700 or £800 insured. The marine insurance policy, ninety-nine times out of a hundred, is what is called a "valued policy": the value is admitted in the policy, and in the absence of mistake, fraud or an over-insurance so gross as to amount to concealment of a material fact, this value or valuation cannot be questioned. It is painful to me to have to record a circumstance so shocking to the fire insurance conscience—but there it is! And I think that in this fact we have the essential—or at any rate a very great—distinction between the fire and the marine insurance policy. And let me make a clean breast of it and confess that marine insurance men even take a shameful pride in the distinction. There is, however, occasion neither for indignation nor for boasting in the matter. Both usages, both laws, are founded on good sense. And the broad operating factor I take to be this: that the property insured against fire is as a rule in the power and possession of the owner, and if he chooses to set fire to it he can do so with no physical risk to himself and with the belief that the fire will destroy all the evidences of his dishonest act. Therefore, it would be contrary to the public interest and safety to let a man stand to make a profit under his fire policy.

Property at sea is in a different position. It is ordinarily in the charge of independent people who have no pecuniary interest in it, and who cannot destroy it without at the same time imperiling their own lives and the lives of all on board. I don't mean to say that this is an absolute safeguard—there are sufficient illustrations to the contrary; but as a broad general rule it holds good. Then there is another reason, that voyages sometimes take long—though nothing like so long now as in the old days when marine insurance had its beginning—and a shipment when it arrives at its destination may well be worth a

great deal more than it was worth at the time it was put on board; and merchants are allowed to insure accordingly.

This, I think, is perhaps the chief of the many ways in which marine insurance differs from fire insurance. It means that in the marine policy, the value of the property is definitely fixed on the signing of the contract. The market may climb to the hills or it may dip to the hollow: a total loss of the goods may be a bit of bad luck for the assured (this happens; but very seldom) or it may be to his undisguised good fortune; he gets the exact sum insured, no more and no less, in either event.

I may, perhaps, mention another point of difference, though it only occasionally takes effect. The amount of your fire insurance policy is the outside amount of your liability. Not so with the marine policy. Take the case of an insurance, as it is expressed, "on hull"; that is to say, on the ship herself as distinguished from the cargo. Shortly after sailing, the ship, by her own bad navigation, is heavily damaged by collision. She puts into port and is repaired, and the underwriters pay the bill. She may get into other trouble after sailing again and incur further repairs, and the underwriters are liable for that, too. Finally, she goes ashore at her destination and breaks up; or is totally destroyed by fire; and the underwriters are liable for the whole sum originally insured, without any deduction for the previous payments.

MARINE POLICY WORDING.

We have been discoursing on some of the differences between the scope or effect of the fire policy and that of the marine policy, but in their language and construction the two documents are almost as different as chalk and cheese. Now, what am I to say about the form and wording of the marine policy? Am I to put myself in a white sheet and shake a deprecating head; or, having myself an antiquarian taste and greatly relishing the smack of words and phraseology long obsolete, shall I proudly declare that, from this point of view, there is no policy like the marine policy? And indeed there is not. For the policy of to-day, in all its fascinating quaintness, is as nearly as may be the policy of three hundred years ago, and for all I know, of a time much earlier. As to the origin of marine insurance, it is lost in antiquity, the English form of policy probably being a translation of that earlier in use in Italy. And one and the same form is to-day used to cover almost any kind of risk you can think of, the same form as was originally framed to meet the case of ancient navigation. To use a homely illustration, the stereotyped marine policy form is like the navvy's iron bucket, which in its early and polished days is used solely for acquatic purposes. Later, becomes leaky, we find it supplementing the uses of the hand-barrow; and finally, punched full of holes, it serves as a useful stove for the melting of lead or

giving to the noonday air an appetizing odor of broiling steak. The insurance may be on sovereigns, on frozen meat, on tobacco leaves in a drying-shed, on tea on the growing plant. Never mind: the policy starts out by declaring itself to be an insurance on the "body" of the "good ship or vessel" named, with all her "tackle, apparel, ordnance, munition, artillery, boat," and so on. Only one boat, be it noted, probably in the early times all she could carry. It is an "omnium gatherum" wording which is about as applicable to modern needs as the navvy's bucket is for making butter. Lest you should regard this description as unduly picturesque, let me quote the words of one of His Majesty's judges (the late Mr. Justice Walton) in one of his judgments not many years ago. This is what he said:

"The difficulty in this case arises from the very peculiar way in which contracts of marine insurance are expressed. A printed form which dates back to the eigthteenth century (early in the seventeenth century, he should have said) is used as a basis of the contract. In this form there are certain blank spaces in which it is usual to insert a description of the subject-matter of the insurance or of the special line of indemnity intended to be given by the policy. It not uncommonly happens that the words written in the blank spaces of the form have no connection with the printed words which precede or with those which follow them. In almost all cases certain parts of the printed form have no application to the risk described by the written words. Sometimes it will be found that many even of the special clauses contained in printed slips gummed on to the policy have no possible application to the actual insurance. Cases are not uncommon in which the whole contract is contained in the written definition of the termini of the voyage, and a few written words inserted below in some blank space in the form, none of the printed clauses of the form being applicable at all; the well-known course of business in formulating contracts of marine insurance."

The learned judge mentioned "special clauses gummed on." Clauses are, in fact, gummed on galore—gummed on, plastered on, stamped on. There are policies which seem, at first sight, to be a sort of documentary hoarding for the display of contractual notices—some of which, as the learned judge justly observed, have no possible application to the actual insurance.

I don't hesitate to say that if such a system were to be seriously proposed as a new thing to-day it would be received with a shout of incredulous laughter. "Then," you will exclaim, "Why not alter it?" Alter it! Not for worlds! Since the days of good Queen Bess the courts have never ceased to determine, in case after case innumerable, the exact meaning to be attached *to every* clause, every sentence, every single word, I may say, *of the ancient* and incoherent contract, and by the light of

this interpretation all the further clauses gummed on, plastered on and rubber-stamped on have to be and daily are interpreted. It is true that in the last few years the law of marine insurance has been codified, whereas, before, it was scattered up and down in the law reports like plums in a cake; but the hoary policy and the legal decisions founded on its every word are the warp and woof of the marine insurance act. Consequently, if the almost Biblical language and archaic terminology and arrangement of the policy were to be altered so as to make it as clear and simple, as spick and span as we all know the fire policy to be, the mercantile community would be cast headlong from the firm ground of well-known and well-understood law into the quicksands of uncertainty and dispute.

Before we go further I would like to say a word or two about that beautiful term—a veritable "Mesopotamia" to fire insurance men—Indemnity.

CONTRACTS OF INDEMNITY.

The policy of marine insurance is, as we know—like the policy of fire insurance and of accident insurance—a contract of indemnity. Now, fire insurance people, brought up in the sure and certain faith that under a contract of indemnity the assured can recover no more than he has lost—that is the best that can happen to him—may well wonder how, when the contract of indemnity is one against marine risks, he can be legally entitled to recover a possibly large speculative profit in addition. The fact is, I think, first, that the description "contract of indemnity" is merely a generic one, as distinguished, say, from a contract of carriage, a contract of hiring, and so forth. It is a contract to indemnify. Whether the indemnification actually agreed upon shall be half the amount of the actual loss, or the exact amount of the actual loss, or the actual loss plus an estimated or speculative profit is beside the question so far as concerns the type of contract, which in all three cases is still and always what the law calls a "contract of indemnity." Now, second, it so happens that the fire policy is really a contract of indemnity as this word is commonly understood; the assured cannot recover more than his actual loss. But that is because of the express provisions of the fire policy. He cannot recover more than this, not because an insurance contract is a "contract of indemnity," but because the fire insurance contract is a form which gives him no more than an indemnity. The marine insurance form gives him what may be, and very often is, a great deal more than an indemnity, though it may also be a good deal less.

So that, as I have conveyed, the fact seems to be that the term "contract of indemnity," like many other terms, is used in two different senses; the one which merely describes the category or class to which the contract belongs—and this takes in the marine insurance policy; the other, which defines the scope

of the policy itself, which makes the fire policy a contract of indemnity in both senses. Our language contains many such ambiguities. "Salvage" is another of them. Look up in the dictionary and you will find three separate and different meanings given to it. There is the property which is saved by an act of salvage; the work or service rendered in the process: the money award or reward for the successful rendering of the service. Look, again, at the word "insurer," which may impartially mean the owner of the goods which he causes to be insured, or the underwriter who grants a policy on them. To avoid this ambiguity the owner of the goods is frequently referred to in marine insurance circles as "the Assu'red"—accent on the "red."

SALVAGE.

But let us go back to salvage. You fire insurance people are familiar with two of its meanings, the process of salving and the product of the work, but of the other meaning, "salvage award," you probably have no, or very little, practical experience. It is, however, a frequent charge on marine insurance policies. A broken-down steamer is towed into port; a stranded vessel is got afloat; a fire in the hold is extinguished by the aid of another crew; in all these cases "salvage" is awarded, and the payment is borne pro rata by all the parties benefited, who in turn recover from their underwriters.

Now, salvage, in the sense of salvage award, is a very curious thing. It is an attribute, a very ancient attribute, solely of the sea. As such, it has been incorporated in the merchant shipping act, so that the liability to pay salvage frequently arises under the marine insurance policy. But this ancient law of the sea is construed with the utmost strictness. It is not merely because property is picked up at sea and salved that its recoverers can claim salvage. No; the only property giving rise to such a claim is a ship or wreck or any of her apparel, or cargo out of a ship or wreck—and nothing else. Now, a few years ago, a floating navigation gas beacon got adrift off the Humber and was saved by two punt-gunners who smothered her light and brought her into safety. By so doing they not only saved £600 worth of Trinity House property, but removed a danger to navigation. Trinity House offered them £6 as a gratuity. They declined it and claimed salvage. I should tell you that this beacon was ship shaped, about fifty feet long and twenty feet beam and bow-shaped at both ends. She had no mast or rudder, but was provided with a hold in which the gas was stored. The salvors' claim was tried in four different courts, the last of these the House of Lords. The Lords decided that the beacon was not a ship or a wreck and that the gas in her was not cargo; consequently that the Trinity House was not liable to pay salvage to those who recovered her, though there was no

law to prevent their paying a gratuity if they liked. A bad day's work for the punt-gunners when they brought her in! In these times of German lawlessness, when merchant ships which have been torpedoed do not always sink, there is a fine chance for salvors, and the underwriters pay, for the most part, cheerfully. But unless the property picked up at sea comes within the strict definition of the act, nothing at all is legally due; the "salvor" is in the same position as you are if you dash into a burning house and save a valuable picture. Except under the merchant shipping act, no one can impose a legal liability on another by saving his property—or his life—unasked.

FIXING OF PREMIUMS.

Rightly or wrongly—I dare say, quite wrongly—marine underwriters like to think that fire insurance rates of premium are so standardized that to fix the rate for a particular risk is like helping yourself to a match out of a box to light your pipe, or looking at the clock. You, with your instructed knowledge, may perhaps repudiate such a view, but you will probably recognize that the business of marine insurance must needs offer an extremely wide field for the fixing of rates; and you may wonder how they are fixed at all. Well, they are fixed, after all, much as the fire insurance premiums are fixed—by statistical experience. This is how it is done:

Each day's acceptances are entered, one beneath the other, in a book: ship, voyage, nature of goods, rate and amount of premium, and so on. Then each entry is separately extracted and re-entered in the sub-division or classification of voyage to which it specially belongs. Thus the risks outwards to Australia via Suez Canal will be grouped together, and similarly the risks via the Cape; two separate categories. Then these voyages homeward will be similarly grouped; two more separate categories. And so with the voyage—voyages out and voyages home—to and from almost everywhere. Ships, as distinguished from cargoes, will be treated separately, more or less; ships insured for time kept apart from those insured for a particular voyage; mail steamers distinguished from tramps; and so on and so on.

Then when claims or losses are paid, or premiums returned, they are first entered more or less together in one book and then, in their turn, they are extracted and posted each against its own policy entry, in its proper classification. So that each statistical group or classification shows in one column the premiums received, and in a parallel column the settlements or returns of premium. At intervals the two columns are added and the totals compared; so that over a term of years it is easy to see at a glance whether the premium for this particular voyage calls for any alteration. All underwriters work more or less closely on this system, and the result of their common experi-

ence is to evolve a standard rate, which, if somewhat elastic, is still a standard rate. I may perhaps add that there exists also, among the companies at any rate, a sort of counter-check. Each merchant's account is kept separately, premiums on one side, losses on the other; so that this method of double statistics must needs keep the premiums under close control.

AVERAGE.

A marine insurance policy "with average" has a very different meaning from a fire policy so effected. The primary marine insurance meaning of "average" is damage; partial loss; charges. Marine insurance claims are either for loss—meaning total loss—or average, meaning a loss which is not total.

Sea-water damage is known as "particular average," and marine insurances on cargo are either "free of particular average," which means that the owner of the goods runs his own risk as regards sea-damage; or "with average," which means that if the goods are sea-damaged he can recover under the policy. For a "with average" policy the premium is rather higher, varying according to the degree of susceptibility to damage. Now, it works out this way:

Say that if the goods had arrived undamaged they would have realized £100, but that, being sea-damaged, they only fetch £80. There you have a depreciation, what is called a "particular average," of 20 per cent.—an injury or "average" to the particular goods, as distinguished from injury or "average" to the combined or "general" interest. That particular average of 20 per cent. has to be applied to the insured value. It is this meaning of the word in the marine policy which, I take it, has been borrowed to describe a form of fire insurance under which the compensation to be paid is to be based on the relation which the lesser sum insured bears to the real and greater value of the property at risk.

Under the marine policy the percentage of depreciation or "average" is ascertained by comparing sound and damaged values, and the percentage thus arrived at has to be applied to the sum insured. If, in the case supposed, the goods are only insured for £80, then 20 per cent. on that will give a claim of £16 as against the loss of £20. If the actual value happens to be identical with the insured value, the claim will, of course, be £20, the amount of the actual loss. If the insured value is £120—and it probably will be some such figure as that—then 20 per cent. applied to £120 will give an "average" or recovery of £24, or £4 more than the actual loss. So that if a large and very valuable shipment be in question and the damage be serious and the over-insurance perhaps 30 per cent. or 40 per cent., the owner of the goods will make quite a handsome profit out of it. That such a thing should be possible may, I am aware, will make dead and gone fire insurance

managers turn in their eminently respectable graves, but I am here to tell the truth. I should add that, over and above the percentage of his loss, applied to the sum insured, the owner of the goods is also entitled to recover extra charges arising out of the damage—the cost of special handling, of certificates of sound and damaged values, and the like. *And* the cost of what is called the "Average Adjustment."

For you must understand that, while I have illustrated my explanation by rudimentary figures, when you have a large shipment of goods of many different qualities and corresponding sound and damaged values and different degrees of damage, and perhaps, as in the case of sugar, loss of weight to be made good, or, in the case of jute or leather, increase of weight to be allowed for, elaborate and voluminous calculations are required. These are made by a firm of "Average Adjusters," who, naturally, charge a fee for their work, which is highly technical, and this fee forms an addition to the claim.

We have just seen that insurance on goods are either "with average," in which cases the underwriters run the risk of sea-damage, or Free of Particular Average—shortly known as "F. P. A."—in which the risk of sea-damage is borne by the assured. But now here comes in an interesting and important exception in the F. P. A. policy: the insurance is F. P. A. "unless the ship be stranded, sunk or burnt." There are refinements of this exception, but we can confine ourselves to the first, that of stranding, as typical of the rest. If the ship be stranded, the fact, as it is technically said, "lets in the average"—that is, it converts the policy into a "with average" insurance.

Now, first of all, what *is* a "stranding"? A stranding is a grounding as distinguished from a striking: it means such a contact with the ground, or some object fixed to the ground, as shall bring the ship to a stop. It may be only for a minute or two, but if the ship be really and unmistakably aground and held fast, she is technically stranded, even though she may become released in a minute or two. But the grounding, to constitute a legal stranding, must be unforeseen and accidental and out of the ordinary course of navigation. In tidal waters, for instance, at certain places, it is the usual or common thing for a ship to "sit on the ground" at low water. That is a grounding, but not a "stranding." Now, see how it operates. Imagine an old vessel with a cargo of wheat from Australia or the Pacific. Wheat, like corn, fish, salt, fruit and seed, for example, being peculiarly damageable by sea-water, is alaways insured F. P. A. The ship meets with a succession of violent gales, leaks like a sieve, and is only kept afloat by her pumps. Her cargo, worth when shipped £40,000 or £50,-

000, is delivered more or less rotten—depreciated 50 per cent. or 80 per cent., say. The policy being F. P. A., there is no claim under it. But in coming into dock, by bad management or perhaps because the vessel is, with her sodden cargo, very deep in the water, she sticks for a minute or two on the dock sill. This is technically a "stranding," and, though it caused no damage whatever, the mere fact of the stranding converts the policy into a "with average" insurance. You have, I think, nothing so sporting as that in your fire policy.

TWO KINDS OF AVERAGE.

Then there is another thing you have not got; you have not got General Average. Particular Average is, as I have said, accidental average—damage or charges—attaching to a particular object, a particular part of the cargo; or, if an insurance of the ship be in question, accidental damage to the ship herself. General Average is loss, damage or charges, incurred by or on behalf of the whole adventure generally—ship, cargo and freight; and this loss, damage, or charges must be incurred, or inflicted, not accidentally, but intentionally, deliberately. And it must be done in a moment of emergency in order to save both ship and cargo from total loss.

For example, a ship runs aground, and in order to get her off she has to be lightened by throwing cargo overboard. The loss of the cargo is General Average. Or, instead of throwing cargo overboard, the ship's engines are worked when she is aground, a use for which they were not intended. Sand gets into and damages the bearings, or the propeller is bent or broken by striking the ground. This is a voluntary sacrifice of the ship's engines for the general safety; the damage is General Average. Or a fire breaks out in the cargo, and the hold is flooded in order to save the ship and cargo, with heavy damage to cargo. This, again, is General Average. These are just simple illustrations out of many. In each case the loss or damage was voluntarily and deliberately incurred in a moment of common or general peril for the general safety. Therefore, General Average.

And, being General Average, it has to be borne generally, *pro rata,* on the value of each interest or package saved, and on the value of the ship and on the money, if any, due to her as freight. And if a ship be broken down or be picked up derelict at sea and be brought into safety by salvors, the salvage awarded to them has, in like manner, to be apportioned over the whole; it is practically, though, I think, not technically, General Average.

VALUES OF CARGOES.

Now, before considering the apportionment and collection *of this* General Average, let us just leave marine insurance for

a moment. I wonder if you have ever considered what is the carrying capacity of that mammoth thing, that engineering marvel—the modern steamship? If not, the time, if we glance at it, won't be wasted, even if it diverts us, or seems to divert us, from our particular—and fascinating!—subject of marine insurance.

You will know, of course, that ships are now built of 30, 40, 50 thousand tons gross measurement. These giants are, however, passenger steamers, which carry very little cargo in proportion to their size. We may have cargo ships perhaps of 20,000 tons, but 10,000 tons is common enough; so let us take a ship of about 10,000 tons gross measurement. A Board of Trade ton is 100 cubic feet capable, in rough and ready terms, of containing 2½ dead-weight tons of goods which are neither light nor heavy. A 10,000 ton ship, after allowing for engine space and so on, will carry about 16,000 tons of ordinary cargo. At any rate, we will suppose a ship carrying 16,000 tons of cargo. Now, the size of railway trucks varies, but though they are now being made bigger, let us take their average load at 8 tons. Therefore, it will take 2,000 trucks to empty the ship. A train of 3c loaded trucks is a very long one—too long if the gradients are steep; but take it at 30 trucks. And we want 2,000—66 trains of 30 trucks each. But first let us look at our 2,000 trucks in a row. The extreme length of an 8-ton goods-truck, nose to tail, is 18 feet (6 yards). Multiply our 2,000 trucks in a row by 6, and you get 12,000 yards of trucks—7 miles of trucks, and all full of goods out of a single ship. You will remember how I remarked, at the beginning, that the fire insurance business is like a vast lake, always growing bigger and bigger, because always being filled and filled by the mighty river of ocean trade which flows into it unceasingly. This single shipload will help you to see what I mean.

GENERAL AVERAGE.

And now we can get back to General Average, and you will be, after our little digression, better able to realize what a General Average claim means in the case of a big modern ship. Seven miles—or, of course, less in the case of a smaller ship—of cargo to be valued, every separate lot of it; hundreds, possibly a thousand, different consignees. If the General Average shall have been damage caused in extinguishing a fire, every package to be surveyed, the sound values and damaged values ascertained and certified; and, more than that, ordinary sea-damage distinguished from what we may call the firemen's damage. Bills for handling, surveying, "making merchantable" and so forth—sheaves and sheaves of them; a cartload, possibly a wagonload of documents. They all go to an Average Adjuster who sorts and classifies them and

enters them into a book, carrying each item into its own column, or perhaps sub-dividing the item into several columns. I have in mind a general average which took four years to make up—"adjust" is the approved expression—at a fee of 2,000 guineas to the adjuster—very well earned—and with a cost of £380 for printing copies of the wonderful work—for every underwriter is supposed to have a copy of it in order to "examine" the claim before he pays it. The "average" is worked out to a decimal point, and every shipment contributes *pro rata* according to the value saved by the general average sacrifice or expenditure. The book or "adjustment" is sometimes nearly as big as a tomb-stone and just about as digestible.

No, you haven't got anything like this in fire insurance—or, for your own sakes, I hope not! And the humorous thing about it is that for the most part it is entirely unnecessary. It is a survival. No doubt the very earliest form of marine insurance was an agreement or understanding that, if one man's goods were jettisoned or sacrificed, he should be compensated by a *pro rata* contribution by all the rest. Merchants travelled with their goods in those days, and Tiglath would not agree to the sacrifice of his bale of rugs, instead of Pilesah's baskets of dates, unless the owner of the ship and all the other cargo-owners agreed to stand in with his loss. Eventually came in marine insurance as a recognized system and a merchant whose goods are sacrificed, whether the policy be with average or F. P. A., is now able to go straight to his underwriter for compensation. Then, two or three years afterwards, the underwriter gets back through the shipowner the contributions of all the other co-adventurers. He gets it back, less, of course, his share of the cost of the whole solemn foolery; and I may tell you that, broadly stated, the cost of applying all this general average machinery works out at about 12 per cent. addition to the actual loss.

OBSOLETE PRACTICES.

You may ask why, then, is it done? I was reading a book on Russia the other day in which it was stated that a Russian peasant's plow is very frequently part of a tree with a short and sharpened bit of the branch projecting from it as a plowshare. Close by, a modern plow, or a steam tractor, may be in use, but he does not care about that: "What was good enough for my father and my grandfather," he says, "is good enough for me!" And that is the only answer I can give you.

Fire insurance may have got some foolish things about it, but either for antiquity or for foolishness it does not begin to compare with marine insurance. But, after all, this is *hardly fair to mar*ine insurance. General average is an an-

cient law of the sea and maritime insurance has to adopt itself to facts, as it finds them. The general average system, now that we have a scientific and universal system of marine insurance is, to a very great extent, if not entirely, an obsolete nuisance to everybody except the average adjuster. It ought to be amended in its system of collection or even abolished altogether; but what is everybody's business is nobody's business. So we go on plowing with our tree-trunk. We go on with a fifth and costly wheel to the coach of commerce.

And here I close my remarks. My lecture, I know well enough, has been a lecture of omissions—like the Irishman's handkerchief, holes strung together. But in the brief space at my disposal I had to choose between giving you the webbing which connects the holes, and the countless little stitches which should fill them. I decided on the webbing. If I had filled up my allotted time with technicalities, you, if you are like your lecturer, would probably have forgotten one half and mixed the other half up with it. I have tried to give you some salient points and to do so in a way which would assist you to remember them.

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